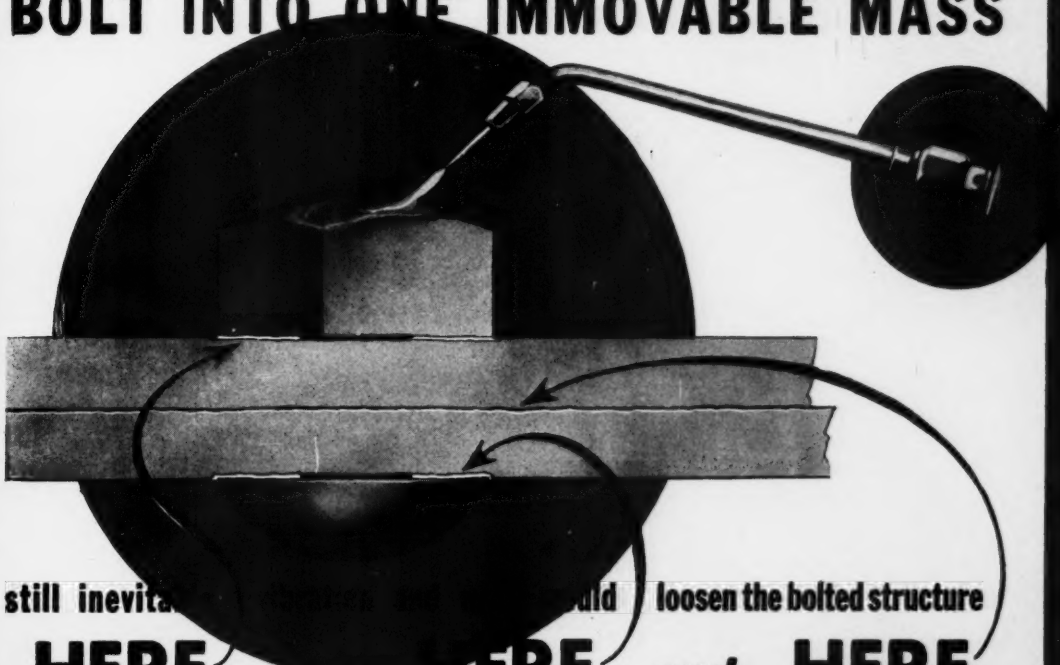
Railway Engineering and Maintenance

EVEN IF YOU WELDED THE NUT AND BOLT INTO ONE IMMOVABLE MASS



still inevita[illegible]uld loosen the bolted structure

HERE and HERE and HERE

ONLY A SPRING WASHER CAN SUSTAIN THE BOLT TENSION UNTIL THE TRACK MAN COMES AGAIN.. *only a spring washer!*

That is why Hipower Spring Washers more than pay for themselves in reduced upkeep costs—less labor and maintenance—fewer renewals and repairs.

IMPROVED HIPOWER

DOUBLE HIPOWER

NATIONAL RIB WASHER

ANKOR HIPOWER

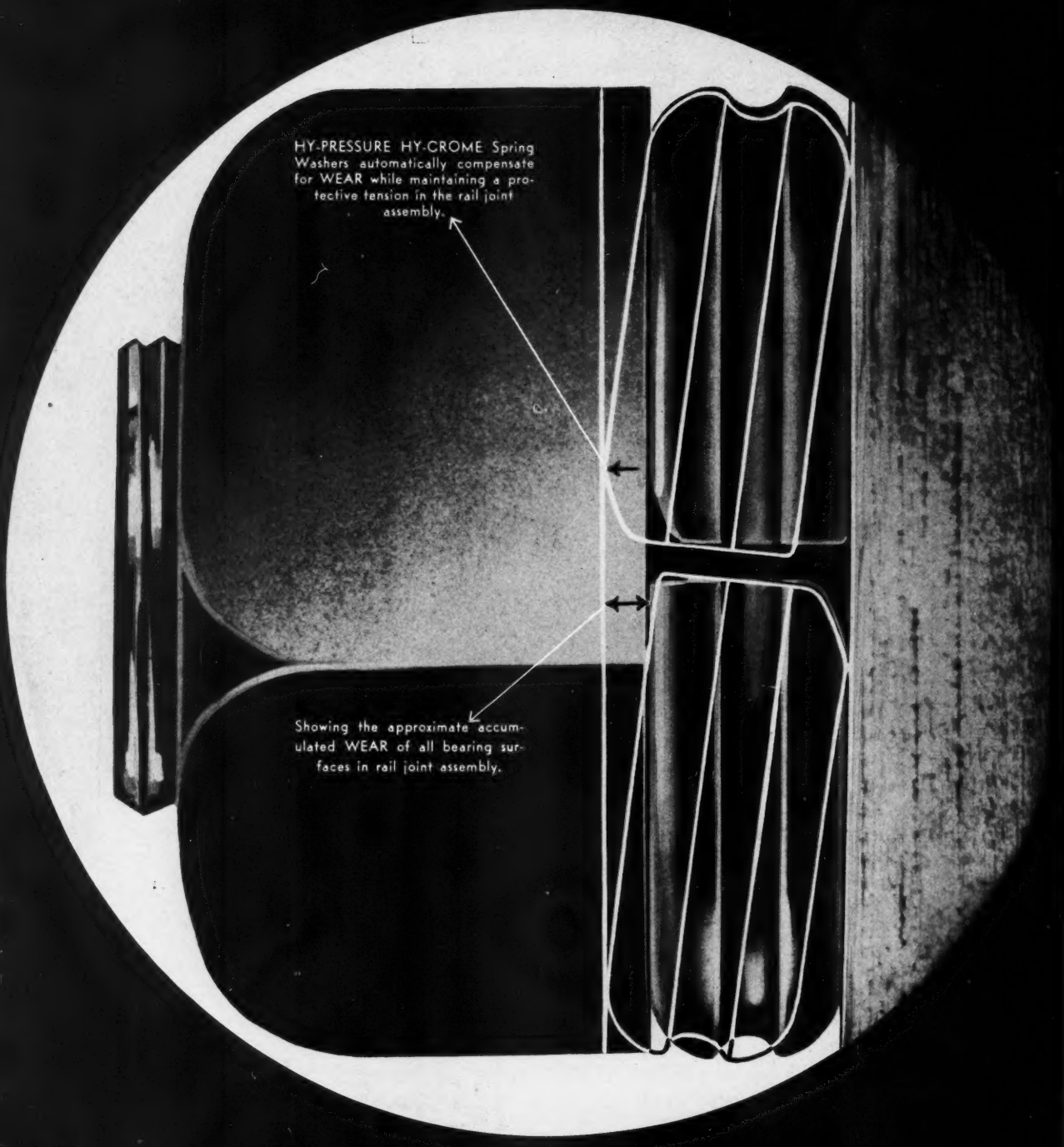
NATIONAL COLLAR GROOVED

THACKERAY SPRING WASHER

THE NATIONAL LOCK WASHER COMPANY, Newark, N. J.

Spring Washers • Retaining Rings • Drop Forgings • Car Window Equipment • Railway and Bus Windows

Reliance HY-CROME *Spring Washers*


HY-PRESSURE HY-CROME Spring Washers automatically compensate for WEAR while maintaining a protective tension in the rail joint assembly.
Showing the approximate accumulated WEAR of all bearing surfaces in rail joint assembly.

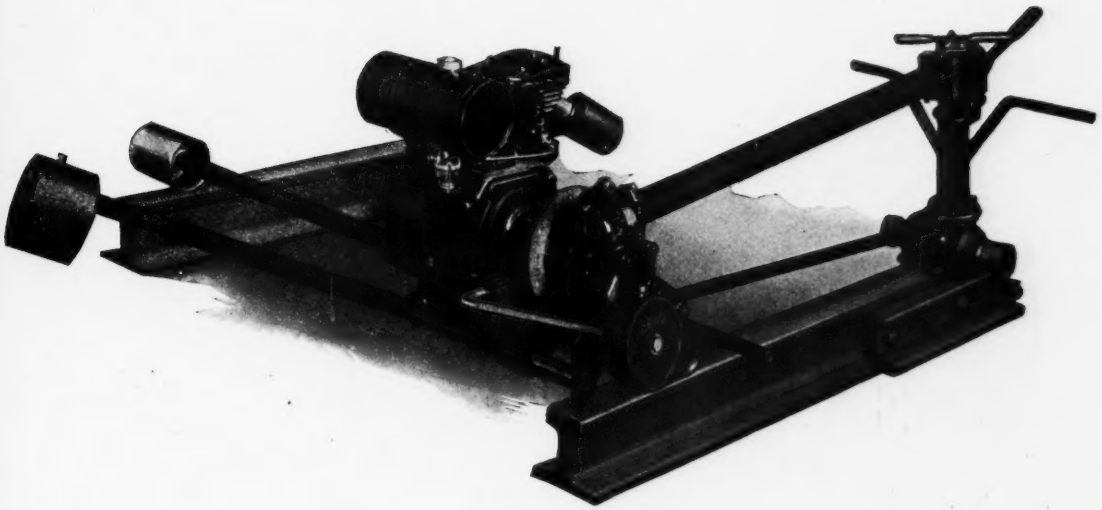
RELIANCE HY-PRESSURE HY-CROME Spring Washers for track joint use, represents our latest development in this type of spring washer — maximum reactive values — wide reactive range — non-fatiguing and sufficient holding power — "The Edgemark of Quality."

An assembly under Spring Washer tension shows less wear over a period from impact loads and intermittent stresses — Spring Washers automatically compensate for wear and lengthen maintenance periods while prolonging life of assembled parts. HY-PRESSURE HY-CROME provides this protection.

EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, O.

Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

Raco Power Track Machine



A marvel of efficiency at low cost.

One man operation.

Weighs only 350 pounds (a two man carry).

Low weight, counterbalanced operating head and convenient and easy controls make for maximum speed with minimum fatigue of operator.

Designed and built for hard, continuous service.

Uniform tension on all bolts—

Allows equal expansion and contraction at all joints.

Minimizes rail batter.

Lessens chipping.

Prevents angle bar deformation and excessive wear.

Uses fewer bolts.

Lasts several times as long as hand tightening.

RAILROAD ACCESSORIES CORPORATION

MAIN OFFICE

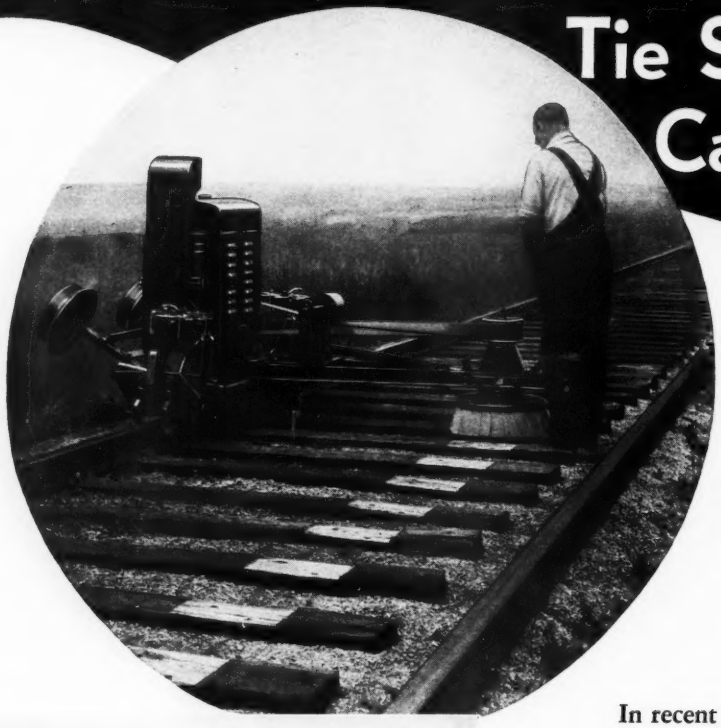
405 LEXINGTON AVENUE

(Chrysler Building)

NEW YORK

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

New Rail Deserves The Best Tie Seats That Can Be Had



Here three Nordberg Adzing Machines are being used by a 160 man rail laying gang. From one to four machines are ordinarily used, depending upon the size of the rail laying operation.

NORDBERG POWER TOOLS FOR TRACK MAINTENANCE

Adzing Machine	Precision Grinder
Spike Puller	Surface Grinder
Power Jack	Utility Grinder
Track Wrench	Rail Drill

Track Shifter

In recent years, there has been a decided swing to machine-adzed ties, some roads insisting that all new rail must be laid on tie seats which have been machine-prepared. With the investment involved in rail and fastenings, the foundation for rail should be as perfect as it is possible to provide. Past experience has proved that improperly prepared seats are conducive to damaged rail and tieplates. It is also a cause for throwing track out of line and gauge.

The Nordberg Adzing Machine was developed to overcome these difficulties. In addition to providing the better quality of track demanded by faster and heavier traffic, it is a big factor in the reduction of rail laying costs. When considering next year's rail laying program, include the Adzing Machine and other Nordberg Power Tools for your maintenance jobs.

NORDBERG MFG. CO.

MILWAUKEE, WIS.

NORDBERG MAINTENANCE MACHINERY

Performance ON THE JOB COUNTS

20 H. P.
4 CYLINDER ENGINE

4 SPEEDS EITHER
FORWARD OR BACKWARD

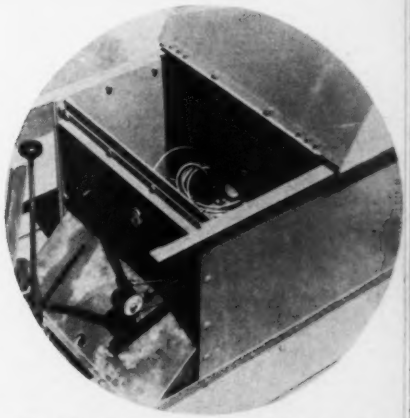
ALL PARTS
EASILY ACCESSIBLE

Fairmont A3 SERIES B

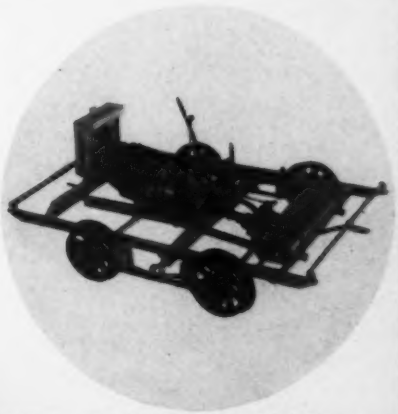
B&B AND EXTRA GANG CAR

For hauling men, materials and tools in bridge and building maintenance work, for towing mowers, extinguisher cars and other work equipment and as an extra gang car, the new Fairmont A3 Series B car offers many outstanding advantages. With its four speed transmission, the Fairmont A3 Series B is **the only car of this class** that provides serviceable speeds, ranging from 2 to 25 miles per hour. At top speed, the draw bar pull is ample for hauling two trailers loaded with 11,700 pounds of material. Spacious carrying trays accommodate unusually large loads. There are 25⅝ sq. ft. of deck space. Cock-pit control provides automobile convenience with full vision both ways for extra safety. The gear drives in oil, all the way, from engine to wheels. It is built like a modern truck with reversible bevel gear drive on rear axle. Investigate the Fairmont A3 Series B car for your road.

FAIRMONT RAILWAY MOTORS, Inc.,
FAIRMONT, MINNESOTA

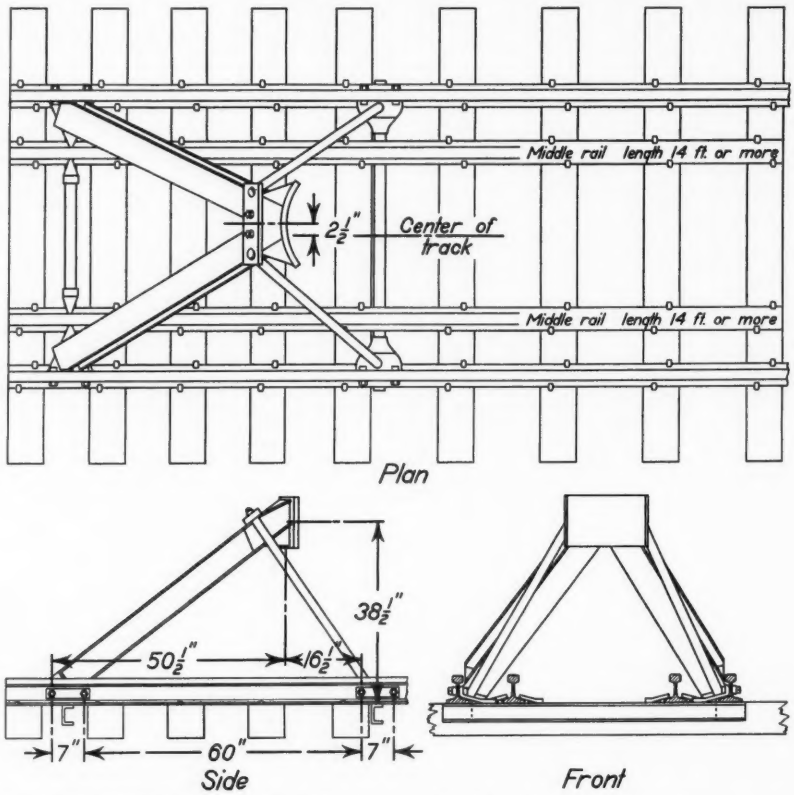


● For cleaning spark plugs, tightening fan belt or making inspections of the engine on the road, the seat above the engine is hinged so that it may be easily lifted out of the way.



● The entire body can be lifted from the chassis by removing 4 bolts and disconnecting the controls.

F ALL THE CARS IN SERVICE TODAY
MORE THAN HALF ARE FAIRMONTS



The Hayes Type WDC Bumping Post has a curved striking face for stopping passenger cars

It was formerly the usual practice to stop passenger cars by means of a high bumping post engaging the platform. But with the heavy equipment of today this method frequently results in damage to cars.

Stopping passenger cars by coupler contact has the great advantage of utilizing the excellent draft gears with which these cars are now equipped. The draft gears are made for just this kind of use; cars are stopped without damage to the draft gears nor to any other part of the cars.

The striking face of a bumping post for passenger use should be curved to center the coupler at contact. The long overhang of the end of a passenger car and the consequent wide swing of the coupler make this necessary for efficient action.

The Hayes Type WDC Bumping Post may now be seen in many passenger terminals. As in all Hayes Posts there is ample clearance for metallic hose connections and it provides for the use of middle rails to make a firm foundation for the post.

Hayes Track Appliance Co., Richmond, Indiana

HOLDS TRACK *to* PERFECT GAUGE

NO MATTER HOW HEAVY THE WHEEL LOAD OR SIDE THRUST . . .

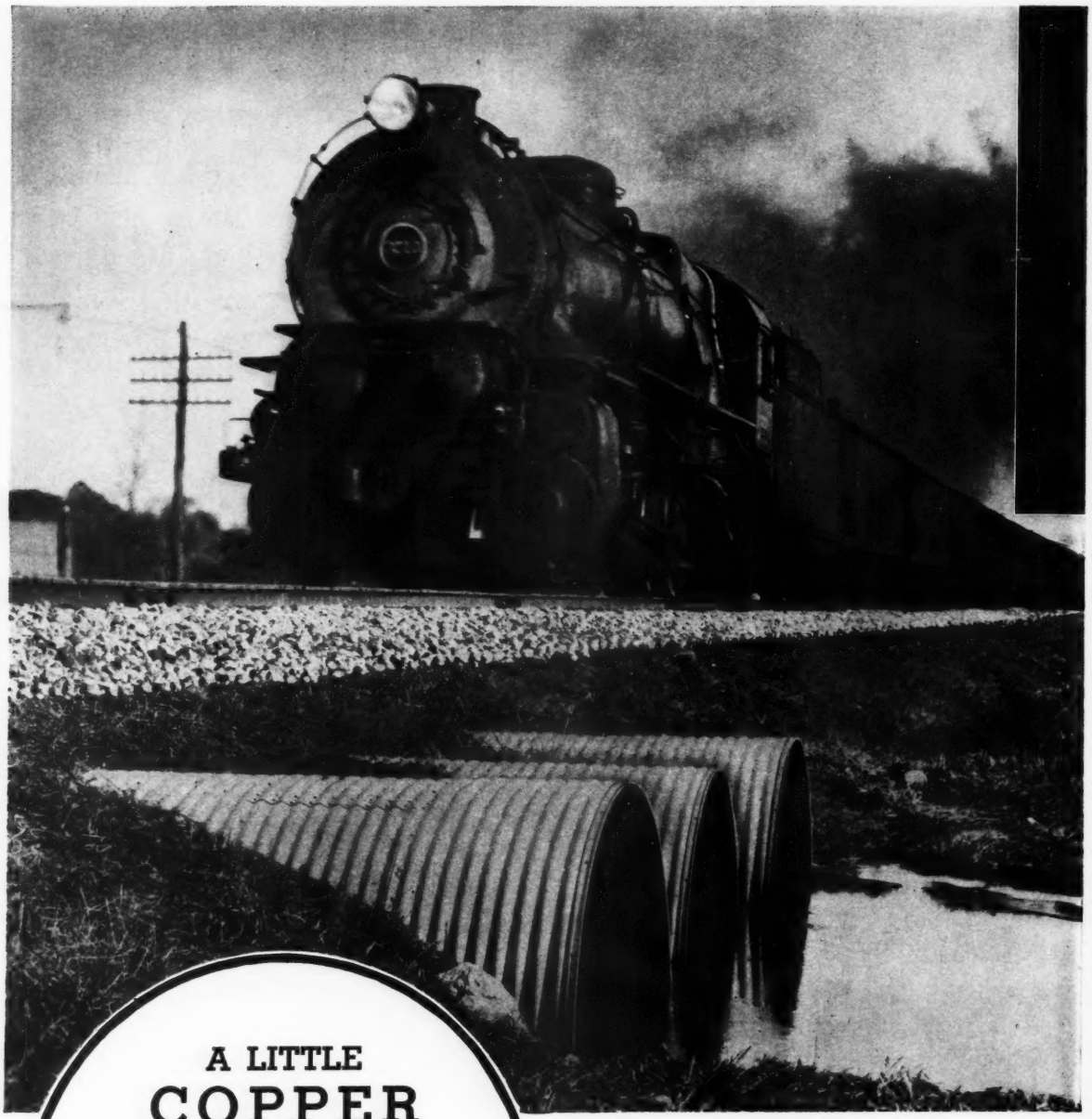
LUNDIE Tie Plates are designed to form a scientifically correct rail bearing for modern track. They distribute the load evenly on ties, without injury to the wood—give proper inclination to rails and maintain perfect track gauge.

Over 200,000,000 Lundie Tie Plates are in service prolonging the life of ties and giving mute testimony of their reliability with low cost of track maintenance. Specify them for your 1938 budget.

THE LUNDIE ENGINEERING CORPORATION

19 West 50th St., New York 59 E. Van Buren St., Chicago

LUNDIE TIE PLATE



A LITTLE COPPER ADDS A LOT OF Protection

A fraction of one per cent of copper added to molten steel considerably lengthens the life of steel when subjected to difficult corrosive conditions. This has been proved by our own tests, as well as the long service of U·S·S Copper Steel Sheets in many fields.

Drainage structures are quickly installed when you use metal culverts. Short-time construction, long-time service—explains why culverts fabricated from U·S·S Copper Steel are so widely used for structures such as this.

STRENGTH
LOW COST CONSTRUCTION
LONG LIFE
ECONOMY

. . . ALL Found in Culverts of U·S·S COPPER STEEL

METAL culverts are strong. The recognized strength of metal is reinforced by the sturdy curve rolled in fabrication . . . further strengthened by the repeated arches of the corrugations. They can withstand heavy loads, excessive and frequent vibration, as well as extra stresses resulting from sub-soil movements.

Metal culverts are easily and quickly installed. Small sections can be laid by workmen without the use of special tools, while a simple rope and pulley device is ample equipment for the heavier sections. Savings in labor and equipment are economy factors worthy of your consideration in the choice of culvert materials.

In U·S·S Copper Steel you find high quality steel fortified against corrosion by the addition of a small percentage of copper. Protect your investment in materials and installation costs. Specify that your culverts be fabricated from U·S·S Copper Steel Galvanized Sheets. Corrosion of these sheets is further retarded by a heavy, even coating of zinc—applied by the "hot-dip" process. This unites the steel and the protective zinc in a tightly adhering bond.

Even after long years of service, culverts made of U·S·S Copper Steel Galvanized Sheets can be taken up and moved to new locations, should the occasion demand it. This is the true measure of culvert economy.

U·S·S COPPER STEEL GALVANIZED SHEETS

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

ESTABLISHED 1880

PETTIBONE MULLIKEN track materials are the outgrowth of research and manufacture extending through 57 years of continuous railroad service.

The PETTIBONE MULLIKEN CORPORATION is now, in even greater measure, devoted to the production of special track materials and accessories of superior quality . . . products that will reduce maintenance costs and assure utmost reliability.

Modern plant equipment and expert engineering facilities are your guarantee of complete and satisfying services.

33 ACRE PLANT

Largest Single Unit Devoted to the Production of Track Materials

INCLUDING

- Split Switches
- Crossings
- Frogs
- Switch Stands
- Mechanical Switchman
- Switch Locks
- Asselin Permanent Base Crossing

and many other devices

1937

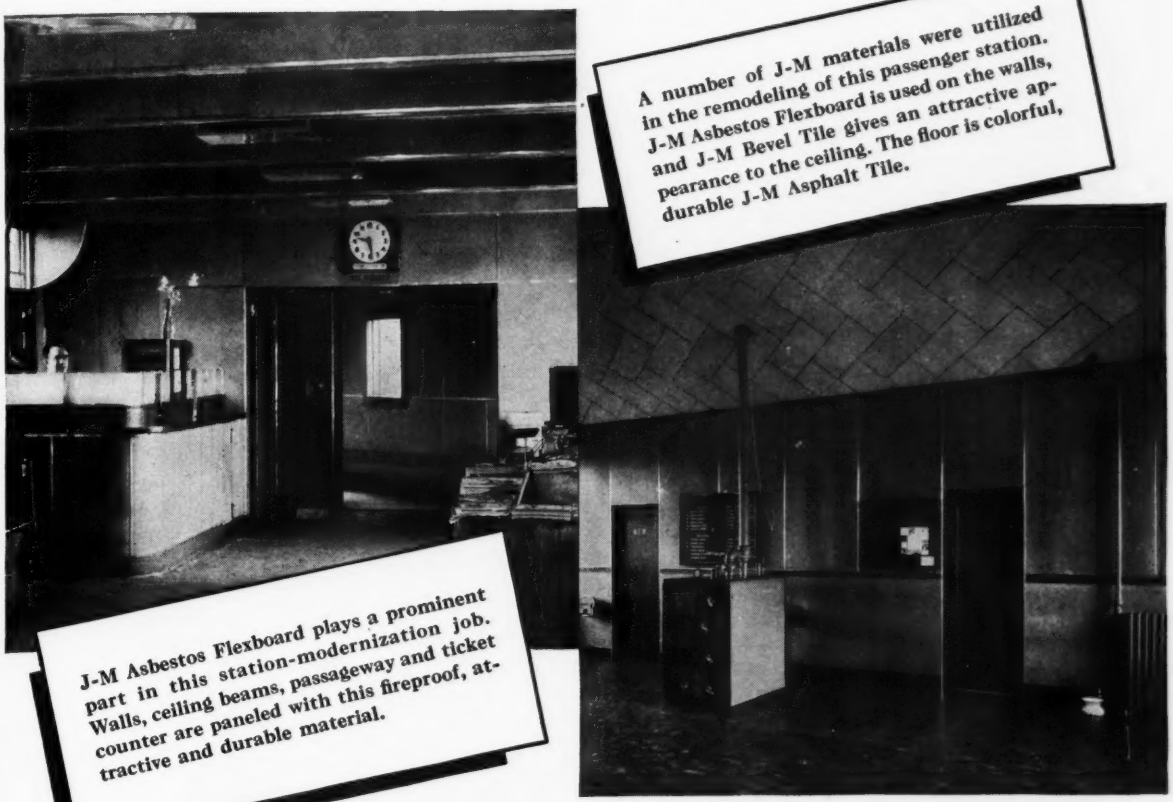
PMCO

TRADE MARK REG. U.S. PAT. OFF.

PETTIBONE MULLIKEN CORPORATION

4710 West Division Street -:- -:- Chicago, Illinois

Modernizing for Tomorrow...



A number of J-M materials were utilized in the remodeling of this passenger station. J-M Asbestos Flexboard is used on the walls, and J-M Bevel Tile gives an attractive appearance to the ceiling. The floor is colorful, durable J-M Asphalt Tile.

J-M Asbestos Flexboard plays a prominent part in this station-modernization job. Walls, ceiling beams, passageway and ticket counter are paneled with this fireproof, attractive and durable material.

Dressing up stations? Investigate J-M materials. Their basic permanence and negligible upkeep promise attractive appearance and low maintenance cost for years to come

OBVIOUSLY, modernization is playing a vital part in the railroads' plans for meeting changing conditions in transportation.

And just as obvious are the advantages of modernization that looks past the present into the future. In other words . . . renovation or new construction that employs materials of inherent permanence and negligible upkeep . . . materials that *remain* modern.

Products and services answering that description have earned for Johns-Manville a record of improved performance and lowered maintenance costs in every branch of transportation.

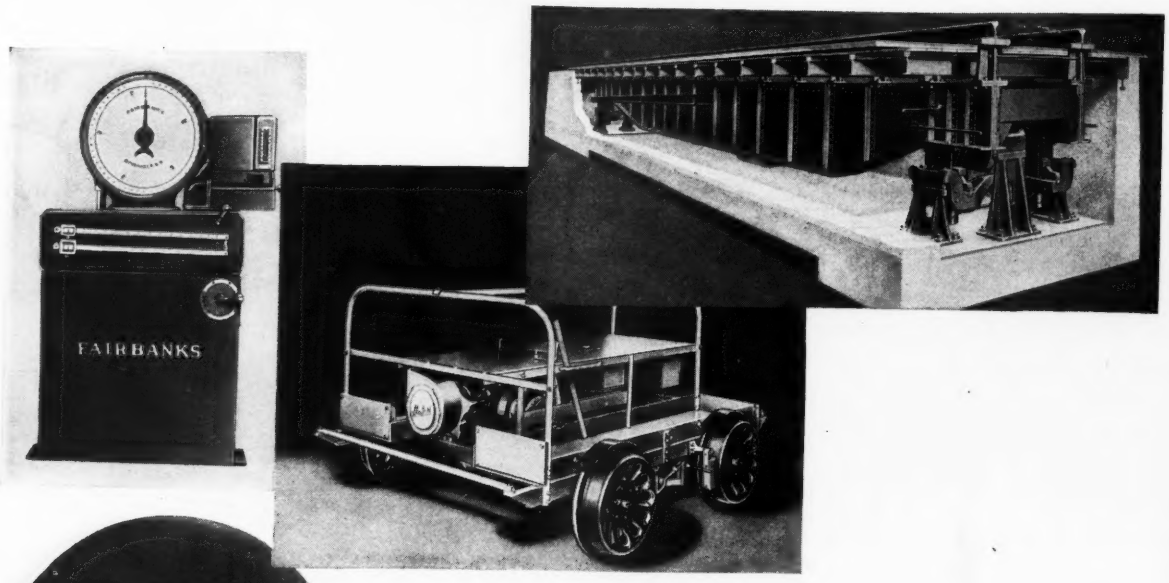
Consider station modernization, for example. Here, J-M Asbestos Flexboard and Wainscoting and various J-M Insulating Board products offer a wide range of attractive finishes and designs. For floors, there is decorative, durable J-M Asphalt Tile. For ceilings, J-M Acoustical Treatment or J-M Bevel Tile. And for exteriors, fireproof, permanent J-M Asbestos Roofs and J-M Asbestos Siding Shingles.

. . .

These and many other Johns-Manville materials carry forward a 79-year service record of improved performance and lowered maintenance costs in every branch of railroad operation. For complete information on any Johns-Manville product, write Johns-Manville, New York, Cleveland, Chicago, St. Louis, San Francisco.

Johns-Manville *Service to Transportation*

J-M MATERIALS CARRY ON A 79-YEAR SERVICE RECORD



"What don't you have?"

asked a purchasing agent of one of our men recently

"WHEN we want track scales, you bring us Fairbanks. When we need motor cars, you have Sheffields for us. When we're planning a new yard standpipe or an isolated coaling station, I call you in. When there's an air conditioning job to be done, we want your axle generators. The electrical department swears by your motors, and we handle our water in this very terminal with your pumps."

The Fairbanks-Morse Railroad family *is* a large one. But we've been serving the many needs of railroading since '69 when Thaddeus Fairbanks helped to build the old Portland and Ogdensburg. With this background of experience, we have built both the products and the service that railroading requires. For full information on any of our products, address Department 88, Fairbanks, Morse & Co., 900 S. Wabash Avenue, Chicago, Illinois.

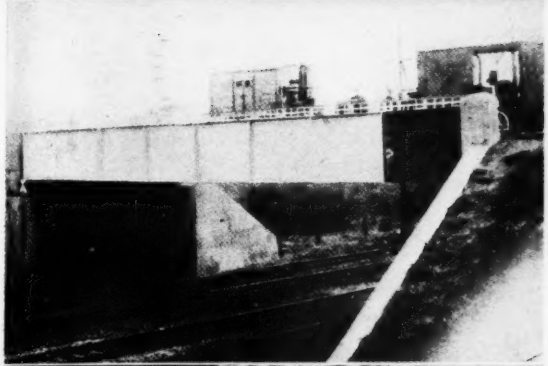
7283-RA21.102

FAIRBANKS MORSE

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER SYSTEMS
REFRIGERATORS
RADIOS
WASHERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

Railway Equipment

Maintenance Costs Cut with these 3 processes



Rail End Welding

Building up and heat treating rail ends is one of the most important operations performed by maintenance engineers of Airco railroad customers. It assures comfort to travellers, smooth handling to shippers, and efficiency and economy in maintenance programs to the railroads. Our engineers would be glad to discuss rail end welding and heat treating with you.

METALAYER

In the process known as MetaLayeR, any of the commercial metals can be sprayed on to any surface to form an adherent metal coating, permanently protecting the surface against corrosion and disintegration from air, water, gases, chemical fumes, acids, etc. At the left, the girders of a highway bridge are being coated with aluminum to protect against smoke corrosion.

Rail End Cropping

Using the Airco-DB Radiagraph, this new and faster method enables a road to profitably crop old and corroded rails in less time and at a fraction of the cost of other methods in common use. Actual cost data secured under working conditions from one road showed savings as high as 18 cents per finished rail end. With the scrap price of rail ends practically constant, this road made a profit of 12 cents on each rail end.

Airco Railroad Customers have reduced their maintenance costs to a minimum through the combination of Airco Oxygen and Acetylene, Airco-DB Apparatus, and Engineering Assistance.

AIR REDUCTION

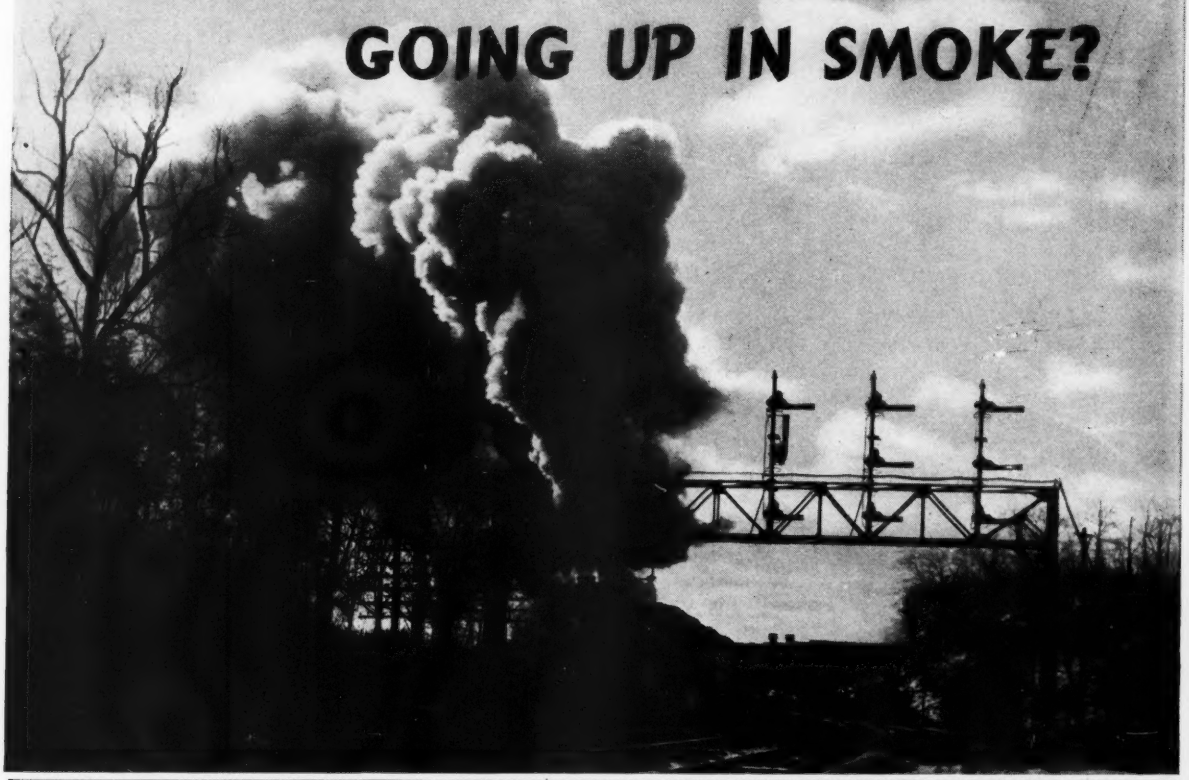
SALES COMPANY

General Offices: 60 East 42nd Street, New York, N. Y.

DISTRICT OFFICES in PRINCIPAL CITIES

A NATION-WIDE WELDING and CUTTING SUPPLY SERVICE

ARE YOUR SIGNAL EQUIPMENT MAINTENANCE COSTS GOING UP IN SMOKE?



MEASURE YOUR PAINT COST BY THE *performance yardstick*—

SIGNAL EQUIPMENT certainly leads a tough life. Day in, day out, it is attacked by dirty smoke, acid fumes, dust and dirt. In addition, another deadly enemy to paint—the weather—is constantly at work trying to break down protective film. Blazing sun, rain, sleet, snow, salt air—all do their best to chip, crack, and corrode the finish.

Many modern roads are using Du Pont DULUX to keep painting costs down. Its vivid colors are especially suited for signals, switch stands and targets. And DULUX is amazingly *durable*. It keeps its original brilliance a far longer time than orthodox finishes—lengthens the time between repaintings—saves money.

DULUX Metal Protective System for new construction gives the steel structures themselves greater protection for a longer time, just as it is doing on so many bridges, towers, transformer stations as well as all kinds of rolling stock.

Have you investigated the economy of DULUX? If not, your overhead may be higher than necessary. A Du Pont representative will be glad to call and give you complete information. E. I. du Pont de Nemours & Co., Inc., Finishes Division, Wilmington, Delaware.

LONG-LASTING BRILLIANCE WITH DULUX ALUMINUM

Two large railroads, with trackage totaling 14,878 miles, have adopted Du Pont DULUX Aluminum for all signal equipment.

The DULUX vehicles give maximum leafing of the aluminum flakes, thereby giving greater brilliance to the finish. This DULUX vehicle also gives continued better appearance as well as the utmost in protection.

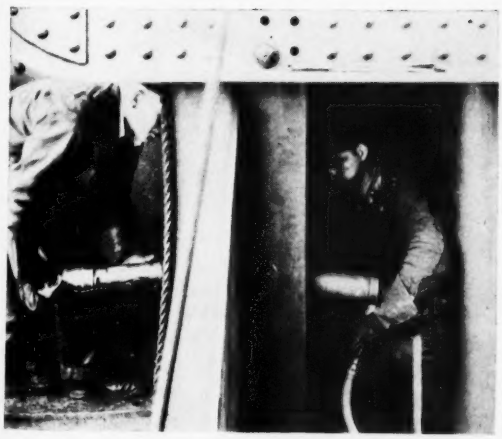
DU PONT
REG. U.S. PAT. OFF.

TRANSPORTATION FINISHES

Faster Better BRIDGE REPAIRS

with I-R Pneumatic Tools

Cleaning a steel structure with Size 16 Scaling Tools.



Riveting Hammer and Holder-On in use on Bridge Work.

INGERSOLL-RAND Impact Wrenches cut hand wrenching time by a wide margin. On bridge work savings up to 90 per cent have been effected in bolting-up time with traffic resumption many hours sooner. They're excellent for wrenching in those hard-to-get-at places.

I-R Riveting Hammers have a great driving power with negligible "kick-back." When used with the I-R Holders-On, this balanced combination insures a tight and permanent job.

I-R Pneumatic Scaling Tools are ideal in close quarters and around rivet heads for knocking off rust, scale and old paint.

Other I-R labor-aiding Air Tools include the rivet buster, air drills, reamers, wood boring tools, the safety-first air saw, grinders, etc.—all outstanding tools effecting substantial savings in time and costs. Let us send you full particulars.

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

Knoxville
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

"LET 'ER SNOW I'll keep *my* 14 switches open"

HE'S not exaggerating. Let blizzards rage; he can still keep his 14 switches open. They are equipped with Winter King Switch Heaters!

Winter Kings are low-cost, effective tools for fighting snow at switch points and frogs. They burn kerosene; use only a few cents' worth a day. Fuel capacity is 1½ gallons, enough for nine or more hours of burning. With six to eight heaters per switch, one man can easily look after a dozen to 15 switches.

With Winter Kings you can be certain that switches will stay open, that trains can go through, regardless of weather. Remember the storms two years ago? One road had 4000 Winter Kings to keep open 240 main-line switches, 40 double slips, and half a dozen single slips. Had no trouble with any of these—cut the maintenance force from a good many hundred men to less than 50 for these switches.

Order Winter Kings now. Install them on all main-line switches immediately, before winter sets in. At the first sign of snow, light them—let heat clear the snow as it falls. Next spring remove them, store them for another winter. Cost is low. Saving in maintenance should pay for them even before *this* winter is over.

BETHLEHEM STEEL COMPANY

WHAT A PLEASURE NOW TO "TAKE THE TRAIN"!

BESIDE the carpeted platform the new stainless-steel train stretches its gleaming length. Passengers are arriving, laughing, chatting and saying good-byes. The colorful, luxurious observation lounge is filling. In the flower-gay diner the white-clad waiters stand at their posts. Again in this modern day there is the thrill of travel—the happy anticipation of a delightful railroad journey.

This is the reality which thousands of pleased travelers experience today—every day. Five years ago only a vision in the mind of a great engineer—four years ago only plans on the draughting table—today there are ten of these light-weight stainless-steel trains in operation, covering more than two million scheduled miles per year.

They are fast trains, because the Budd type of construction reduces the weight to be pulled by nearly one-half. And they are supremely *safe* trains because the stainless steel of which they are built has four times the elastic strength of ordinary steel.

Herein lies the chief difference between the various kinds of streamlined trains. Some are conventional heavy equipment with streamlined exteriors. Others compromise on alloys which give medium weight. But Budd-built trains are *truly* light-weight, combining modern streamlining with the strength of stainless steel, welded by the exclusive Budd SHOTWELD process.

And best of all, these trains are filled. They have stimulated rail travel. Whether drawn by steam, diesel-powered or electric locomotives, they decrease cost of operation by eliminating excess dead-weight. They are profitable to the railroads as well as an immense service to the traveling public.

Originator of ALL STEEL bodies for automobiles, now used almost universally, the Edw. G. Budd Manufacturing Company has pioneered modern methods in the design and fabrication of steel products.

EDW. G. BUDD MANUFACTURING COMPANY

PHILADELPHIA AND DETROIT

BUDD METHODS SAFELY ELIMINATE DEAD-WEIGHT

TIMKEN
TAPERED ROLLER BEARINGS

The bearings used by Budd play their very important part in the realization of "What a Pleasure to 'Take the train' ", by helping to attain maximum speed, comfort and economy. TIMKEN Bearings are used in an overwhelming majority of all streamlined trains operating on American railroads.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Good Right-of-Way Fence is the Best "NO TRESPASSING" Sign

THE sure way to offset the increased danger of loss of life, injury, or stock claims is to install reliable protection with good right-of-way fence. New, faster trains and heavier schedules make this more imperative now than ever before.

American Railroad Fence and Banner Steel Posts provide sturdy and long-lasting right-of-way protection. They are easily installed . . . one man can drive a hundred or more American Banner Steel Posts in a day. The patented slit wing anchor locks each post in the ground as solid as a rock. And because no fence can be stronger than the posts which support it, it pays to get the additional strength that National Expanding Anchor End and Corner Posts (dirt set) will give to your fencing.

This fence will give long service because it is made of Copper Bearing Steel, evenly and heavily galvanized. It has proven through service its ability to withstand difficult corrosive conditions. The firm, but flexible, American Hinge Joint resists the weight and pressure of livestock.

Protect stations, yards, shops and buildings with this fence, too. Further information will be furnished on request. Let us show you how this durable and economical fence will reduce your losses from claims by giving sure protection to your right-of-way.

U·S·S AMERICAN RAILROAD FENCE *and* BANNER POSTS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
COLUMBIA STEEL COMPANY, *San Francisco*
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

2 More Roads

Great Northern & Denver & Salt Lake INSTALL CONTINUOUS THERMIT WELDED *Rails*

Thermit Rail Welding is making rapid progress. The trend to continuous rails is growing by leaps and bounds. Important railroads are fast becoming convinced both of the savings to be gained through the elimination of rail joints and of the feasibility of welding rails into long, jointless stretches.

Now two more roads join the roster of pioneers in Thermit Welded track; the Great Northern, with 5700 ft. of jointless track at Rexford, Montana; the Denver & Salt Lake, with more than six miles of welded track in its Moffat Tunnel, 10,000 ft. up in the mountains of Colorado. In addition, the Delaware & Hudson, continuing the work started four years ago, is putting in more Thermit welded track in upper New York State.

With the Bessemer & Lake Erie, the Northern Pacific, the Erie, the Chicago, Milwaukee & St. Paul, and the New York Rapid Transit Corporation, this brings the total number of roads who have installed long, Thermit welded rails up to eight.

These installations are pointing the way, through eliminated joint maintenance and reduced track upkeep in general, to potential savings for American railroads that have been estimated as high as $136,000,000 a year. It will pay you to investigate fully. Write for data.

THERMIT

Rail

WELDING

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

HERE'S ADDED VALUE

AND LONGER LIFE IN THIS IMPROVED RAILWAY CULVERT

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No. 107 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Whose Fault Is It?

Dear Reader: November 1, 1937

A few days ago a railway supply man protested to me about a statement that a railway officer had made to a group of other railway men derogatory to his product. "He was talking about an old design," he said, "a design that we have since improved to eliminate the defect to which he called attention. He ought to have known better." "Wait a minute," I said, "why do you criticize him? Have you ever brought your new design to his attention?" He replied that he could not recall that he had. "Then," I said, "whose fault is it if he doesn't know about it?" He admitted that it was his. "And," I then added, "there are probably hundreds of other men who don't know about it either."

This conversation impressed me with the thought that this manufacturer's problem is the problem of every railway supply company. It is not enough in these days that one make a good product; it is equally necessary that those who might use it be informed as to its merits. This is no simple task, for so many maintenance officers of varying rank and authority influence the selection of materials and devices. They are widely scattered--at headquarters and at outlying points. Furthermore, they are difficult to contact, for they spend so much of their time out on the line.

It is for this reason that Railway Engineering and Maintenance is brought into the sales programs of so many companies, for they know that it goes to practically every maintenance officer since it is his means of keeping abreast of developments in the field. These railway supply manufacturers know also that when you are out on the line, the magazine awaits your return or frequently goes out to meet you.

Its editorial pages bring to you new developments in your field; its advertising pages afford opportunity for manufacturers to ride along into your offices--and to tell you of their products and of their merits.

Yours sincerely,

Elmer T. Howson

ETH:EW Editor

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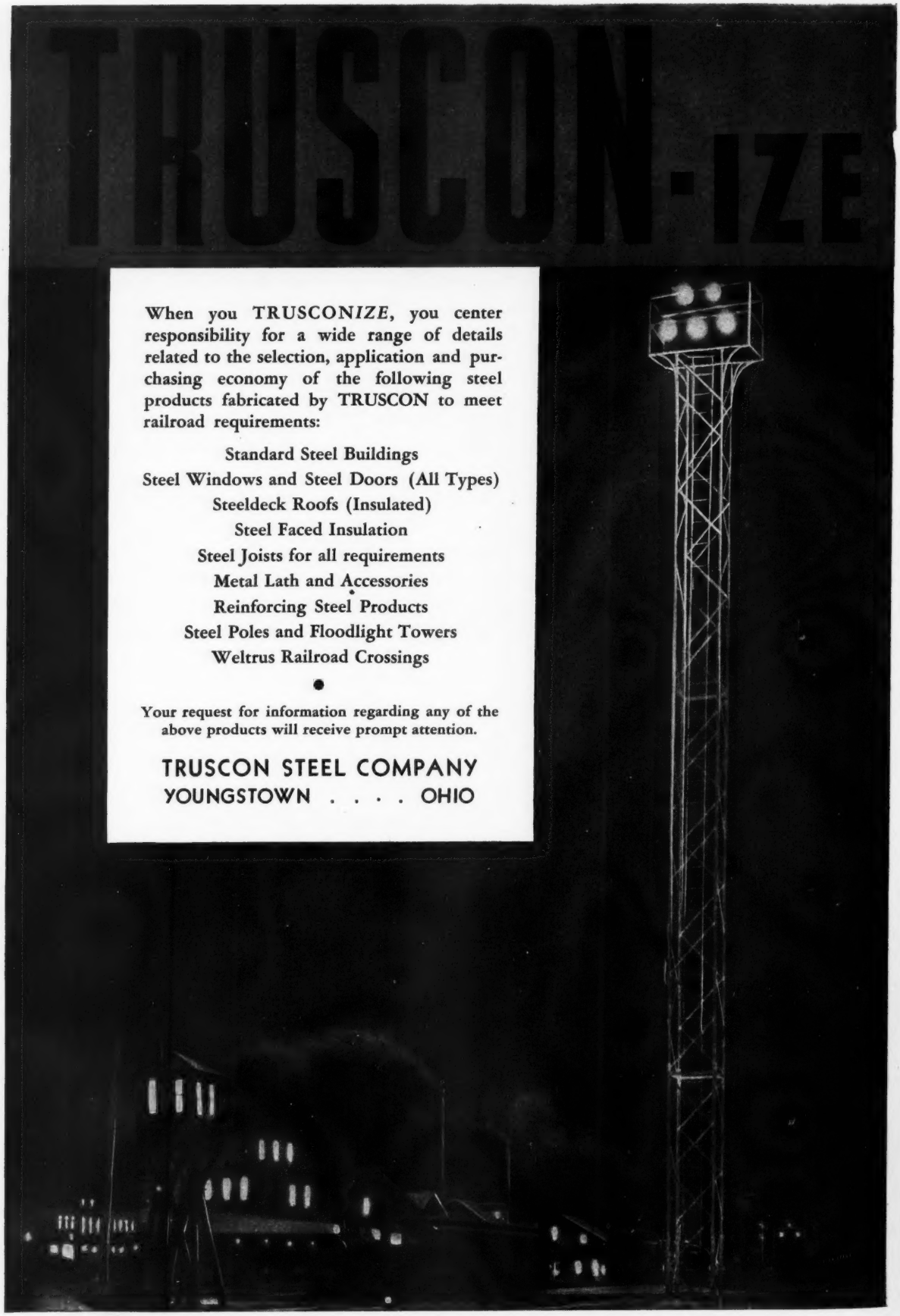


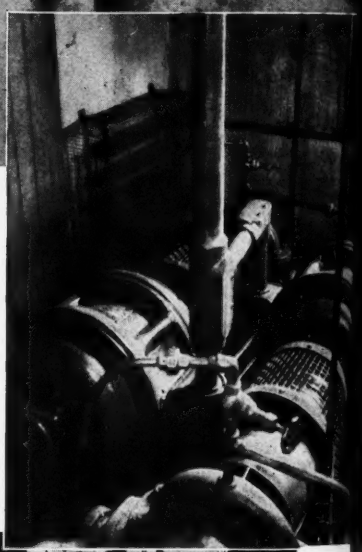
Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

November, 1937

Editorials - - -

No Maintenance Worries



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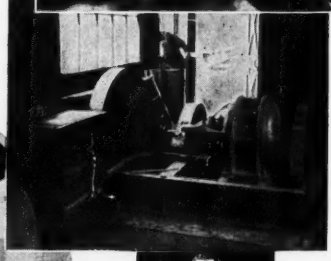

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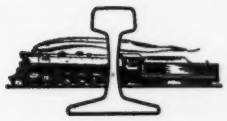


Arithmetic

A Study in Subtraction

IN THESE days when large figures are bandied about with abandon, one tires of statistics. Yet there are some figures regarding railway operations which every railway employee should know and use if he is to promote the interests of his industry and of himself. These relate to the changes that are now taking place in the financial results of the railways.

After several years of greatly reduced income, the railways earned a net railway operating income of $667,000,000 in 1936. While this was a third less than the average for the years 1921-29, inclusive, it was twice that for 1932 and a third larger than the corresponding return for 1935. As such, it demonstrated definite progress in recovery from the depression.

Increases Already in Effect

Influenced undoubtedly by this upturn, the Interstate Commerce Commission abolished the "emergency" surcharge on freight traffic at the beginning of this year. Based on 1936 traffic, this reduced the earnings of the railways $152,000,000 annually.

Turning in another direction, the railways, in common with other consumers of materials, are facing rising costs on every hand, all of which are influenced indirectly and some directly by governmental action. Especially is this true of coal, for which the roads spend more money than for any other material and where the cost is increased directly by the provisions of the Guffey Act. Based on the purchases of materials, equipment and fuel actually made in 1936, rising prices are already adding $125,000,000 annually to railway operating costs.

The railways were subjected to another increase in costs on August 1, when, after extended negotiations and the intervention of a federal mediator, they granted their non-operating employees an advance in wages of 5 cents an hour. This increase is estimated to cost the roads $98,000,000 a year.

Early this month the railways, again after extended negotiations direct and through the intervention of a federal mediator, agreed to a slightly greater hourly increase to their operating employees, which is estimated to add more than $35,000,000 a year to their payrolls.

Still further increases are threatened, especially through the enactment of legislation. One bill now before Congress proposes the substitution of a six-hour basic day for the eight-hour day for train service employees. Another, the full-crew bill, proposes the addition of men to train crews. One of special seriousness arises from legislation that has already been passed by the United States Senate and is now pending in the House, to limit the length of freight trains to 70 cars. This latter bill, if enacted, would add at least $150,000,000 to the operating expenses of the railways.

The Net Result

If we assemble, as deductions from the net railway operating income of 1936, the loss of $152,000,000 resulting from the elimination of the surcharge, the added expenditure of $125,000,000 for increased costs of materials and supplies, the $98,000,000 addition to payrolls for wage increases granted non-train service employees, and $30,000,000 for train service employees, we have deductions totaling $405,000,000 already in effect, leaving only $252,000,000 of the 1936 return, or nearly 25 per cent *less* than in 1932, the worst year of the depression.

If from this amount there should be deducted $150,000,000 for making effective the proposed train-limit legislation, the net operating income of the railways would be reduced to $102,000,000. In other words, these actual and threatened increases in expenses will take more than 85 per cent of the total net railway operating income earned last year.

When it is realized that railway fixed charges, or interest on indebtedness, approximate $500,000,000 a year and that this interest must be paid if the roads are to remain solvent, the seriousness of the present situation confronting the railways is apparent. It is emphasized, also, by contrasting the present situation with that prevailing in the years 1921-29, inclusive, when the net railway operating income averaged more than $1,000,000,000 annually.

Every railway employee has a very direct interest in the solvency of his industry, for it is only in a solvent, growing industry that individual as well as group progress can be made. Obviously, it is necessary for a solvent industry to maintain a relationship between railway income and railway expenses that will leave a sufficient amount to pay fixed charges and, in addition, a sufficient margin to provide a surplus for "rainy days."

In an industry whose earnings are regulated as closely as the railways', it is necessary that they be allowed to adjust their rates to increase earnings sufficiently to meet

rising costs, especially when these costs result in large measure from governmental action. This points to the necessity for favorable consideration by governmental authorities of measures which the railways will be forced to initiate, looking to increased rates.

In these complex days throughout which we are passing, few persons have either the time or the opportunity to familiarize themselves with conditions in other industries or even with conditions within their own industry. The railways have of late enjoyed a liberal measure of public confidence and good will. It is essential to their success that the public be acquainted with the added costs which are being thrust upon them and with the necessity for corresponding increases in freight and passenger rates to meet these rising costs in order that they may continue to render the service that the public has come to expect.

Railway employees, almost all of whom have received increases in pay as a result of these recent adjustments in wages, can render no greater service to their industry at the present time than by utilizing every opportunity to familiarize those with whom they come in contact with these rising costs of operation and with the necessity for comparable increases in earnings.

Thermal Insulation

Does It Pay in Railway Buildings?

AT PRESENT the railways are in no position to indulge in luxuries. Barely emerged from a severe and long-continued recession in traffic to face a period of rising prices, they must of necessity consider carefully the economic results to be obtained from the expenditure of every dollar, whether for maintenance or for betterments. This does not mean that every investment must pay a high direct monetary return, for if expenditures were made on this basis only, the railways could afford to spend almost no money, except for the replacement of worn and damaged units of the facilities necessary for their operation, for few expenditures made by the railways for the improvement of their fixed properties pay direct returns.

On the other hand, many of the improvements which the railways make have large economic value for they pay high returns indirectly; facilities for softening boiler waters, heavier rail sections and preservative treatment of ties being well-known examples of the truth of this statement. A material which is not so well known among railway men, but which has repeatedly demonstrated its economic value in other fields is thermal insulation for buildings. In fact, the high economic value of thermal insulation is so well recognized in some quarters that the broad statement has been made by responsible officers that no railway can today afford to erect any building which must be heated, without including adequate thermal insulation as a part of the construction; or to make major repairs to such buildings without applying insulation.

As with other materials, thermal insulation is not a cure-all for every evil which affects the comfort of occupants of buildings. If it is properly applied, however, and if other channels through which heat is lost are closed, it will not only add greatly to the comfort of these occupants, but will also demonstrate an attractive saving in the cost of the fuel required for heating.

Probably no more wasteful practice exists on the railways than that of heating small and medium-sized stations, offices and similar buildings. This waste is greatly increased by the fact that many, if not most, of these structures were designed to be built at minimum cost, with the result that few of them are weather tight. It is in buildings of this type that the largest relative savings can be made through the use of insulation, in not a few cases up to 75 or 80 per cent a year of the cost of applying the insulation, provided other necessary measures are taken to insure weather tightness, as around door and window frames. Even in the better class of buildings that are usually rated as being weather tight, savings as high as 20 to 40 per cent a year can be made through the use of thermal insulation.

It is not an uncommon experience that through the application of thermal insulation and the installation of a central heating plant, sufficient savings can be made, compared to stove heat, to pay the original cost and carrying charges of both the insulation and the heating plant in from three to five years, after which these savings become clear profit.

It was a timely thought on the part of the American Railway Bridge and Building Association that placed this subject on its program. On a succeeding page of this issue will be found a committee report which, while admittedly presenting only a general review of the field for thermal insulation in railway buildings and of the advantages of its use, is well worth serious study by every officer interested either directly or indirectly in the construction, maintenance or use of buildings. It is hoped that the Association will follow the recommendation of the committee and continue the study of this important subject.

Motor Trucks

In Maintenance of Way Work

THE highway truck is steadily growing in favor as a utility in maintenance of way operation. Having its inception on the railways in stores delivery at terminals, the truck is gradually being applied for other uses. One railroad employs trucks extensively in the moving of its track gangs as well as their tools and materials to and from work. Another has provided them for its water service repair men. Other roads are using truck-mounted welding generators, and in several instances trucks have proved useful in moving the men and materials required for the restoration of lines destroyed by floods.

Because of this trend toward the movement of highway vehicles in place of on-track equipment, it has been suggested that much wider use could be made of them, especially by section gangs in territories where highways parallel the right of way, and this idea will undoubtedly be tried experimentally in the near future, although it is doubtful if this movement will be very far-reaching.

In the first place, the railway line mileage that is readily accessible from parallel and immediately adjacent highways represents only a small part of the total. In addi-

tion, much of the time saved the gang because it does not have to wait for a line-up will be lost in getting through right of way fences or in walking from road crossings.

Still another consideration to be taken into account is the need for chauffeur licenses, and it will be necessary to secure them for at least two men in each gang to avoid tying up the truck in the event that one licensed driver is incapacitated. Further than this, there is the matter of liability insurance, since no responsible owner can afford to operate a highway vehicle without such protection. There is also the problem of track patrolling, because the use of a truck in place of a track motor car implies some substitution for track patrol by the section gang. But even where a track inspector is employed to relieve the foreman of this responsibility, surely some value must be assigned to the added inspection, even though it is a casual one, that is obtained by having an experienced track foreman ride over his section on his way to and from work.

While it is true that trucks have proved exceedingly useful in expediting the restoration of tracks destroyed by washouts, it is to be questioned whether they will prove as practical in ordinary emergencies as the track motor car. When section gangs are called out to patrol their tracks after heavy rains, there is a distinct advantage in having the foreman go over every foot of his track on a motor car rather than to proceed over the highway in a truck and stop along the track only at points where he anticipates that damage *may* have occurred.

The motor truck is a valuable agency in maintenance of way work, and its application will be extended as new uses are found for it. But it is not to be expected that further application of the highway vehicle will result in any appreciable supplanting of the track motor car.

Fighting Snow

Preparation Is Half the Battle

AT THIS time preparations for fighting snow, both in congested terminals and out on the line, should be completed, with all needed equipment assigned and supplies distributed. Ample reserves of the latter should be on hand at strategic points where they will be available without loss of time when needed. Knowledge that snow-fighting equipment is in first-class condition and is placed to best advantage and that there will be no shortage of material or supplies when the emergency arises are of prime importance in any effort to keep trains moving during winter storms.

Yet, all of these preparations are worthless unless corresponding preparation has been made with the snow-fighting personnel. A snow-fighting organization is like an army—it requires training, it needs direction, it should continue at the task to which it is assigned until relieved or ordered back and it needs to be well fed if it is to remain effective. No such organization can be expected to be more alert than its leaders; it cannot be effective unless it is properly directed and understands clearly what is expected of it; this understanding is not possible unless it has been acquired before the beginning of the emergency. In other words, preparation for fighting snow must include all elements—personnel, equipment and supplies.

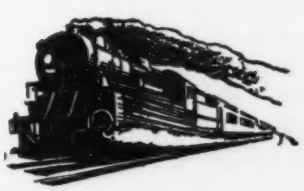
It is of equal importance that a complete plan be worked out, whereby every man who is permanently employed will know in advance where he is to be assigned and what his duties will be. Out on the line there is usually little opportunity to shift local forces and seldom any need for doing so. In a large yard or a busy terminal where this can sometimes be done quite easily and where, on the surface at least, the apparent need to do so arises with considerable frequency, the shifting of regularly assigned forces should be avoided at all hazards. Experience has shown that much confusion is likely to result if such shifts are made, and that it is better to have an adequate mobile force in reserve, which can be sent to points where additional help is needed or where things are not going well for other reasons.

Within the memory of many of the younger men in the maintenance of way department, the requirement that men should be assigned to certain points and remain there, was of decidedly less importance than it is today. Terminals and yards have grown, train movements have increased, interlockings and other track layouts have been extended and, in many cases have become more complicated, so that one needs considerable experience before he can become fully acquainted with these layouts and the movement of trains through them. For this reason, the shifting of forces during an emergency is likely to result in confusion and a decided lowering of their effectiveness.

Furthermore, during the earlier period, main reliance in fighting snow and ice was of necessity placed in picks, shovels and brooms, since little other equipment for this purpose was available. Today, semi-portable oil burning torches, portable snow melting cans, gas and electric heaters, weedburners, etc., are available for use around switches, while power snow-disposal equipment is used regularly for clearing driveways, walks, etc., with the result that one man can now do as much as 4 to 50 men were able to do formerly.

Since the effective use of this equipment requires training and experience, this becomes an added reason why men should be given regular assignments and why they should not be shifted from them, particularly during the period of the emergency. This requirement makes it particularly necessary that the snow-fighting forces be well-organized and have full advance knowledge of their duties.

In fighting snow, as in every other type of work in which the maintenance forces engage, the happy-go-lucky attitude and the hit-and-miss methods of only a few years ago have no place today. They have given way to controlled organization and centralized supervision which reach to every unit of the service, regardless of its importance or relative obscurity, and co-ordinate the whole into a well operated machine instead of a group of independent units, each operating separately.



First Stretch of Butt-Welded Track on the Delaware & Hudson

Building for Today's Traffic*

What One Railroad Has Done to Strengthen Its Organization and Improve Its Track Structure

By H. S. CLARKE

Engineer Maintenance of Way, Delaware & Hudson, Albany, N.Y.

Readers of Railway Engineering and Maintenance have been afforded ample opportunity to become familiar with the pioneer work that has been carried out by the Delaware & Hudson in the butt welding of rails in long continuous stretches. This comprises such an outstanding departure from established practice as to give rise to many questions—especially, with respect to the behavior of rail when restrained against movement. In this article, the officer of the railroad who is primarily responsible for this innovation in track construction presents the background for the development, as well as observations on the behavior of the track in service.

IT MAY be said that most railroads have taken, or are attempting to take, steps to modernize their permanent way to meet the present demands for higher speeds and heavier loads. It is questionable, however, whether the cost of track maintenance will not rise sharply under the hitherto commonly accepted methods of raising the standard of track. Much more comprehensive measures of track construction and maintenance than those which we all used in the late past, are needed to meet the present demands upon the track.

During the last seven years, the Delaware & Hudson and most of the other railroads have been required to maintain their tracks with far less labor and material than any one of us could have conceived to be possible ten years ago, and, in my opinion, it is going to be necessary to continue to do this. Yet, today, we are in a situation where it is absolutely necessary to provide a stronger and better track structure than was ever required before and, furthermore, due to the increases in rates of pay, taxes, and costs of materials, and decreased traffic, this improved structure must be maintained at approximately 50 per cent (or less) than what it cost the railroads on the average, to maintain their tracks between 1920 and 1930. To meet this situation, far-reaching and radical improvements must be made in the standards of track construction, in the programming of the work and in the handling of the track forces.

On September 17, 1929, I addressed this convention on The Stabilization of Maintenance of Way Forces.† Today we are still operat-

*Abstracted from a paper presented before the convention of the Roadmasters and Maintenance of Way Association at Chicago on September 15, 1937.

†*Railway Engineering and Maintenance* for October, 1929.

ing with a stabilized force, but with a force ever so much smaller than we had assumed necessary to keep up our tracks. Yet we are not only doing this, but our track conditions are steadily improving, and our maintenance costs are going down.

We started with a stabilized force in 1927. Previous to that, we had a summer force of approximately two thousand men and a winter force of fifteen hundred. These figures and others which follow include foremen, assistant foremen and trackmen. Under our stabilization plan, we started with a force of 1,550 which remained substantially the same until 1930.

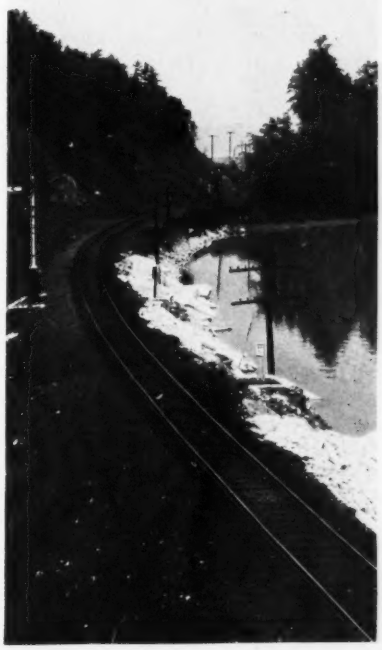
From that time on, no new men were hired to fill vacancies and no men were laid off. However, through resignations, deaths, pensions, etc., the force decreased in the following six years to 1,009 men. This force has been working only four days a week for the past six years, except on extraordinary maintenance, appropriations involving capital expenditures, and construction work, when such work was taken care of by increasing the number of working days to five and, in some cases, to six days a week. The ideal condition, I believe, would be a five-day week, working six days only when necessary to take care of extraordinary maintenance and construction work. Of course, all the credit for such a large reduction in force does not belong entirely to the stabilization of forces, but has been helped to a considerable extent by more and better work equipment.

Other Equipment

The stabilization of forces has led to other changes which have proved economical. In 1925 we had 213 sections; today we have only 125, for with the decreased force it was necessary to lengthen the sections in order to secure workable gangs.

At this point I am going to digress from track maintenance to bring out a few items which have a bearing on decreasing general maintenance costs. During past years, changes in conditions have resulted in changes in operating methods and in the use of facilities. A study revealed that many buildings and facilities could be abandoned and razed. In line with these studies, we found that we were able to tear down 80 stations, or approximately 44 per cent of all stations; 479 miscellaneous buildings, or approximately 32 per cent of all miscellaneous buildings; 30 water stations, or approximately 27 per cent of all water stations; and 14 turntables, or approximately 37 per cent of all turntables; a total of 603 units that had to be maintained, or approximately 33 per cent of all such units on the railway. It was also found economical to abandon several branch lines, and many yard and side tracks. In addition, centralized control installations have resulted in the abandonment of many signal towers.

While these, and many other changes, resulted in decreased maintenance cost, they were not felt to be sufficient, and further steps had to be taken. A steel tie was developed from scrap rail, which, we believe, has almost an unlimited life and, to



The Delaware & Hudson Has Maintained Its Track To a High Standard

date, 150,000 have been installed in yards and sidings, and, to some extent, in curves on branch lines, where no signal circuits were involved.

Stronger Track

Like most railroads, we have been carrying on a program of improved drainage, ballasting with material of suitable type and to an adequate depth, installing hardwood creosoted ties, heavy rail, etc., and have continued to carry on these programs on a somewhat reduced scale through the depression. With the exception of steel ties, most railroads have been taking these same steps, to modernize their permanent way.

We then began to look for still greater economies and, at the same time, meet this situation which required better track that could be maintained more economically. Some of the following points seemed most pertinent to the problem:

(1) While creosoted ties decrease the cost of tie renewals by preventing decay, the treatment is expensive and, to secure full advantage of the investment, the tie must be fully protected against wear and spike-killing.

(2) The rail joint is universally recognized as the weakest point in the track, and if a joint could be as strong as the unbroken section of the rail, or if joints could be eliminated entirely, the problem of track maintenance would be greatly simplified.

(3) It is recognized that more than 45 per cent of the track labor is now consumed in keeping the rail joint in proper line and surface.

(4) More rails are renewed yearly and have their service life shortened by reason of battered and chipped ends than for any other cause, thus presenting one of the major problems in maintenance work.

(5) While new methods of hardening rail ends against batter and a process of reconstructing or building up rail ends has been developed, these improvements are only stop gaps and the full service life of the rail is far from being secured.

(6) If the rail joint could be eliminated and tougher rails could be developed through the use of alloys, they would give a longer service life against wear.

(7) The development of control-cooled rail eliminated many of the anticipated difficulties from transverse fissures developing in rails.

To meet the first condition, a heavy double-shoulder tie plate was developed that is canted and crowned, and fastened to the tie by means of a compression screw spike and independent of the rail fastenings. Thus the tie plate became, in effect, a part of the tie and prevented wear of the tie. The screw spike provides sufficient lateral resistance, the double-shoulder plate maintaining the track to gage. In addition, high lateral forces act on the rail inwardly of the track as well as outwardly, and if the rail is held closely in place when the pull is inward by means of the shoulders, a decrease in the lateral force applied to the other rail will result and the side thrust will be divided more evenly between the two rails.

New Rail Fastening

The fastening of the rail to the tie plate, it was felt, must meet certain conditions. Such fastenings must be able to be tightened up strongly and remain so in order to prevent the rails from creeping on the ties. They must have some elasticity in order to dampen the effect of the stresses developed in the track, and the movement of the tie in the ballast resulting from impact. It must be possible, at any time, even after a number

of years, to tighten up the fastening to take up wear, or renew part or all of the component parts. After many experiments with various types of clip fastenings, the spring clip fastenings now used were adopted and applied with the double-shoulder plate previously described, which was punched to take the fastenings.

With these fastenings, the rail is held by means of two spring steel clips bolted to the tie plate at the center of the crown and bearing on the base of the rail. Since the rail-to-tie-plate fastenings are independent of the tie-plate-to-tie fastenings, each group is free to perform only the work it is designed to do, while the rail, the tie plate, and the tie are co-ordinated into one strong but elastic and flexible unit. The old destructive cut spike is eliminated, the double-shouldered plate holding the track to gage.

One of the 80 Stations that Were Abandoned and Razed

Advantages

The fastening of the rail to the tie plate and through that to the tie by means of the spring steel clips, greatly strengthens the track structure, yet leaves it sufficiently elastic to absorb the impacts and loads applied to it. The vertical motion of the rail and of the tie is greatly decreased compared with that of the old cut spike, or cut-spike and screw-spike, construction, although the normal wave motion of the rail is permitted to pass freely. The decreasing of the vertical motion of the tie means a lessened pounding on the tamped ballast structure beneath the tie, and it is the incessant pounding or pumping of the tie that breaks down the interlocked ballast and causes the track to go out of line and surface. Track with spring clip construction stays in line and surfaces for longer periods of time, resulting in a saving in labor charges.

The further advantages of the steel spring clips are evidenced by the studies made of the vertical movement of the rail and tie, as shown by many tests. It was noted in these tests that the relative motion of the rail to the tie in the spring clip track remained substantially the same in all the tests, which is indicative of the uniformity of this type of track structure. In combination cut spike and screw spike track, this relative motion varies over a wide range and this will always be true of straight cut spike or cut-spike and screw-spike construction. This results in one part of the track going out of line or surface, or both, before another section, making for "spotty" track and frequent working to keep some semblance of uniform surface and line.

The pressure exerted by the spring clip permits the free wave motion of the rail, but does not allow it to progress longitudinally. The rail is held in place and there is no creepage. So well is the rail restrained that changes in length, due to expansion and contraction, are prevented. It was this feature of spring clip construction, combined with several other facts, that led to the belief that it was possible and practical to weld rails into long lengths, lengths limited only by the necessity for insulated joints, and the location of switches and cross-overs.

Cause of Creeping

The tendency to movement by creeping is caused by the running of trains and is always in one direction for the same direction of the moving train. Where this movement takes place, it usually extends over comparatively long stretches of track.

The principal cause is the wave motion of the rail which is set up by the moving trains. There is usually a slight upward and then a downward movement of the rail and ties just preceding a moving locomotive or train, owing to the flexibility of the rail. The ground also springs for quite a depth underneath the track and for some distance each side, so that there results a wave motion in the rail of much greater amplitude than at first appears.

An Undulating Motion

Starting with the fact that there is a wave motion in the rail, it may be explained that if the rail were *continuous*, this wave would be propagated along it simply as an undulating motion and there would be no onward movement in the rail any more than there could be in the ground. But by laying rail in lengths of 39 ft. or other short lengths, the propagation of the undulating motion is more or less arrested at every joint, and completely so where the angle bars are loose. Each length of rail is thus permitted to move ahead. Hence, the running or creeping of rail takes place successively by rail lengths, one rail at a time; or, at most, by a few lengths acting together as one. This is why steel may creep and not close the joints.

Now, if the rail were continuous as the load rolled forward, it would stretch out the rail behind and crowd it together in front, compressing the particles slightly, thus setting up behind an elastic force of tension and, in front an elastic force of compression in the rail. Both of these forces would act to restore the disturbed portion to its former place after the load had passed; thus the rail would undulate with the ground.

With continuous rail, therefore, the tendency for rail to creep or run is avoided by the elimination of the track joint. This is borne out in practice, as experience with continuous rail over an extended period has not shown any tendency to run through the fastenings.

Stresses in Continuous Rail

Observations at various times and places on ordinary track with well-fitting joints have shown only small movements at the joints over a wide temperature range, indicating that large temperature stresses must be present in a great mileage of ordinary track. Creepage in ordinary track not properly anchored adds tremendously to these stresses. It is believed, therefore, that track laid with continous rail and fixed, say, at a rail temperature of 90 deg. F., does not develop any more stresses in the rail than will be found in much of the ordinary track mileage, and less than in portions improperly anchored.

Experiments conducted some years

ago with a 500-ft. length of rail developed that, over a range of temperature changes between minus 20 deg. F. and plus 20 deg. F., the length of the rail was unchangeable as between these limits, and no movement was observed, but above 20 deg. F., the rail was quite sensitive to temperature changes. This fact has a bearing on the ideal temperature for fixing or fastening continuous rail and limits the range of temperature changes that affect the rail in any climate.

Where rail is so fixed that it cannot expand into an extended position when heated and cannot move in any other way, as, for instance, by buckling, it must remain unaltered in length since external forces holding it are greater than the compressive stress set up by the temperature rise. Alternatively, if the rail cools below the temperature at which it is fixed, a tensile stress is created to be resisted by the influence that fixes the rail; that is, the rail is compelled to undergo the stresses set up by expansion of the metal without lengthwise extension and vice versa. These stresses are so far below the elastic limit of the rail itself that they can have no effect upon it and are, therefore, of no consideration in connection with the subject of continuous rail other than representing a force that tends to lengthen or shorten the rail.

Summarized, we have the following:

(1) In long rails, the weight of the rail, in itself, reduces the theoretical amount of expansion or contraction of a rail.

(2) The double-shouldered tie plate has a tendency to bind the rail and further to decrease the amount of expansion or contraction.

(3) The holding power of the spring clips against longitudinal movement in either direction, combined with the above facts, out-balances the forces of expansion and contraction, so that there is no lengthwise movement, except a slight movement at the end rails—not much more than would be expected in 39-ft. rails.

(4) In continuous rail, rail creepage does not enter into the problem, as it does not exist to any appreciable extent.

(5) The ranges of temperature changes that actually affect changes in the length of rail are not the total temperatures of the climate in question, but only from approximately plus 20 deg. F. to plus 130 deg. F., or the hottest day that may be encountered.

(6) In heavy rock ballast, little attention has to be given the temperature at which the rail is fixed, as it can be fixed within a range of, say, 64 deg. F. to 90 deg. F. without fear.

(7) In cinder or gravel ballast, which is lighter and has less holding power than rock ballast, the rail should be fixed within a range of, say, from plus 60 deg. F. to 95 deg. F.

(8) In ordinary track, there are numerous cases of sun kinks, due generally to poorly anchored track, which has been creeping and thus closed the expansion gaps.

(9) Sun kinks in ordinary track are always due to causes which can easily be determined and corrected.

(10) There should be far less fear of sun kinks in continuous than in ordinary track, as creepage does not enter into the problem and the cause of sun kink is better controlled and can be noted and corrected quickly.

By Eliminating Buildings Not Needed, It Has Been Possible to Maintain the Remaining Ones in Excellent Condition

Test Installation

These facts were tested out in continuous rail laid in Albany, N.Y., in 1933, the longest rail having a length of 2,750 ft.; this rail has been in service four years without giving us any trouble. Further installations were made at Mechanicville, N.Y., in 1934, at Schenectady and Windsor in 1935, and at Comstock and Cohoes in 1936 and, this year, all new rail laid is being welded. At the end of this year, we will have 450,000 lin. ft. of welded rail in service, or approximately 45 track miles of continuous track.

This introduction of continuous rail brought up an important and exacting condition that had to be met—namely, a sound, high-quality weld. Extensive studies and research were carried out, relative to the many phases of welding theory and practice, in both Europe and the United States. Exhaustive tests made under different procedures, with the co-operation of expert consultants, have resulted in the development of satisfactory welds.

Test welds have been subjected continuously day and night, to severe rolling load fatigue tests, following a similar procedure in the extensive rail investigations of the University of Illinois and considered the nearest approach to actual service conditions in track. Many other well-known rail tests were also made. Without going into any detail, I will say that the results were satisfactory.

Continuous track has many advantages over track laid with the standard length rails, some of these being as follows:

(1) Joint maintenance is eliminated, including the maintenance of bolts and angle bars, surfacing and lining.

(2) Rail life is increased; there is no joint batter; rail is relaid less frequently.

(3) Rail creepage is eliminated.

(4) Deterioration of the joint ties is eliminated and it is not necessary to space ties.

(5) The replacement of joint bars and the reconditioning rail ends are avoided.

(6) Smoother riding is afforded for passengers.

(7) Rolling stock maintenance is reduced; there is no shock at joints.

(8) Signal circuit bonding is eliminated.

(9) Less tractive power is required to haul trains over jointless track.

While it is a little early to make any reasonably accurate estimate of the reduction in maintenance expenditures resulting from continuous rail and spring clip construction, a substantial saving is already obvious. We have track of this type, put up several years ago, on which there is a fairly heavy traffic, on which no work has been done since and which is in as good line and surface as when originally put up. This track gives every indication of staying in good line and surface for many more years with little if any attention. Railroad men who have been studying continuous rail feel that this development opens up the possibility of securing far stronger, safer and better riding track with a reduction in future maintenance expenditures of 50 per cent or more, plus a now unascertainable saving in the maintenance of rolling stock.

Five Men with Bars Lined the Far End of the Rail into Position as the Crane Handled the Near End

Kansas City Southern Lays 78-Ft. Rail

By A. N. REECE

Chief Engineer,
Kansas City Southern,
Kansas City, Mo.

In keeping with the present trend of thought among maintenance officers, the Kansas City Southern recently installed one mile of 78-ft., 127-lb. rail as a test to determine whether rails of this length are practicable and what advantages, if any, they demonstrate. This article describes the methods used in laying the long rails, and gives the results of preliminary tests to determine the effect of temperature changes on the performance of the rail.

TO DETERMINE the relative advantages and disadvantages of longer rails, early this year the Kansas City Southern laid one mile of 78-ft., 127-lb., Dudley-section rails near Grandview, Mo., about 25 miles south of Kansas City. Except for certain slight modifications which will be mentioned, this rail was produced in accordance with the current A.R.E.A. specifications at the Gary mill of the Carnegie-Illinois Steel Corporation.

These modifications included controlled cooling and the hardening of the ends, certain revisions in the percentages of short length and number two quality, and in the tolerances for length and camber. To control the cooling it was necessary to place two cooling boxes endwise to accommodate the rails during the cooling process. The ends were hardened by heating them with coke-oven gas and quenching in an air blast.

Because of their length it was necessary to double-load them on flat cars for shipment, the number of rails to a load being 39, 39, 28 and 29 respectively. The freight rate was the same as for 39-ft. rails loaded on individual cars, since the smallest double load was in excess of minimum-weight requirements. The rails were loaded alternately head up and head down in layers, consecutive layers containing four rails less than the one immediately below. The bottom layer was supported on two 10-in. by 12-in. cross timbers, each timber being placed about the middle of its car. The layers were separated by 2-in. by 4-in. cross timbers which were placed directly over those resting on the cars. The rails were tied down securely for shipment.

Unloading the Rail

No difficulty was experienced in unloading the rail, for which purpose a steam ditcher was used at one end and an air unloader at the other. The cost was practically the same per gross ton as for 39-ft. rail, the added cost for the steam ditcher being offset by a reduction in the work-train time for unloading. A reduction in the cost for unloading could have been effected if a crane equipped with a 50-ft. boom had been readily available.

Owing to the relatively small quantity—199 gross tons—of rail involved, and because a locomotive crane was not readily available, the rail was laid with a Parsons gasoline-engine-driven rail crane, which has been used for laying 39-ft. rail. The tongs were applied at a point about 25 ft. from the near end and the rail was lifted and swung over the track. Five men with lining bars then lined the far end of the rail into position. The crane then lowered its end of the rail onto the ties and pulled it lengthwise to butt against the rail last laid. With this system, approximately two minutes time was consumed in laying each rail, and the mile was laid in the equivalent of one working day without difficulty.

Cost of Laying

There was a slight increase in the cost of placing the rail, compared with placing 39-ft. rails, because of four additional laborers required with the crane to bar the rail into place, but this was more than offset by a reduction of six man-days in the labor that would have been required for distribution, oiling and applying the 135 joints that were eliminated by the long rail. For this reason, there was some reduction in the total cost of laying the 78-ft. rail, although no special equipment was provided for this purpose. If this length of rail

were to be laid in quantity with cranes having 50-ft. booms, a reduction of $20 a mile for unloading and $20 a mile for laying appears to be attainable.

No changes were made in the track construction, except those incident to the longer rails, the details being as follows: Ballast, chatts (lead and zinc tailings), not less than 12 in. under the ties; ties, 7 in. by 9 in. and 6 in. by 8 in., by 8 ft. long, mostly treated red oak, spaced 48 to the 78-ft. rail length; rail, 127-lb., Dudley section, open-hearth, controlled cooled and end hardened; drilling, holes 1⅛ in. in diameter, spaced 2 15/16, 8 15/16 and 14 15/16 in., respectively, from the rail end, and 3⅛ in. above the base; bolts, nominal diameter 1 in., 5 in. long, heat treated, 6 to the joint, with spring washers; joint bars, 36 in., angle bar type, heat treated, unslotted; tie plates, double-shoulder, 7¾ in. by 12 in., canted 1 in 40; fastenings, 2 cut spikes per tie plate, no independent fastenings; anti-creepers, 12 to a 78-ft. rail length, anchoring against movement in either direction. This rail was laid on the main line between mile posts 24 and 25 from Kansas City, at which point the line is single track. The alinement is all tangent. From the north there is an ascending 0.5 per cent gradient for the first half mile, the remainder being level.

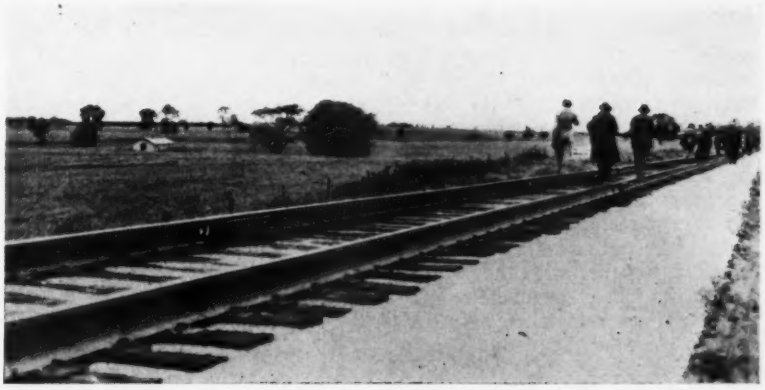
Expansion Allowance

Expansion openings were in accordance with the accompanying expansion table, the rail being laid on April 21 and 22, the operation having been interrupted by rain, during which time the rail temperature ranged from 66 to 95 deg. The rail-temperature range for the year in this locality is approximately 140 deg. For this variation in temperature, the change in length of a 78-ft. rail would be 0.85 in. if free to move without restraint. On the other hand, the rail drilling and bolt diameter permits an expansion movement of only ⅜ in. which is equivalent to the free movement in expansion or contraction through a temperature range of only 62 deg.

Figure 1 illustrates the theory upon which the expansion table is based. In the preparation of the table it was assumed that the joint-bar friction will approximate 75,000 lb., which is sufficient to restrain movement of the rail in expansion through a range of 60 deg. Thus, if the rail is laid with an expansion gap of ⅜ in. when its temperature is 29 deg., movement in expansion will not begin until the temperature of the rail increases to about 61 deg. Movement in expansion will then continue under this restraint until the temperature of the rail reaches 122 deg., at which time the gap will be closed.

Likewise, as the temperature drops from 122 deg., no movement can occur until the temperature of the rail becomes 90 deg., because this drop in temperature is required to release the rail compression produced by the joint bar function. As the temperature continues to fall, because of restraint, movement in contraction will not begin until 60 deg. is reached. The gap will then continue to increase and at zero will be ⅜ in. It will be noted that in the range of 140 deg., between —10 deg. and 130 deg., only 18 deg. remain to be overcome by other forces acting in restraint. The shaded portion of Fig. 1 indicates the area in which the movement of the rail will occur if the joint restraint is 75,000 lb. and it has been laid in accordance with the expansion table.

Before the rails were laid, strain-gage readings were established while the rails were free of any restraint, so that temperature stresses could be determined later after the rail was placed in the track. The first 20 rails on both sides of the track at the north end of the mile were selected for this test. On the west rail, strain-gage points were established at the center of the web at both ends and at the middle of each rail; on the east rail, these points are at the middle and south end of each rail. For comparison, a piece of rail head 18 in. long was planed from a short piece of rail, a hole was drilled in one end to hold a thermometer and strain-gage points were drilled to be used for reference

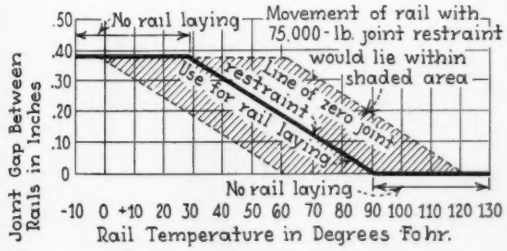


Inspection of the 78-Ft. Rail by the A.R.E.A. Committee on Rail

Expansion Table Used for Laying 78-ft. 127-lb. Rail

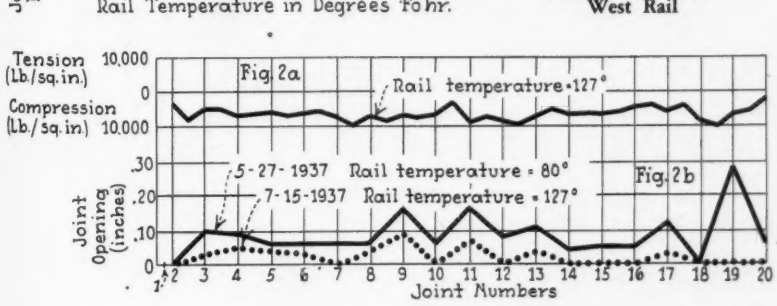
Rail temperature deg., F.	Expansion opening in.
86 to 95	0
76 to 85	1/16
66 to 75	⅛
56 to 65	3/16
46 to 55	¼
36 to 45	5/16
26 to 35	⅜

Rail shall not be laid when the rail temperature is more than 95 deg. or less than 26 deg.


.50
.40
.30
.20
.10
0
No rail laying
Movement of rail with 75,000-lb. joint restraint would lie within shaded area
Line of zero joint restraint
Use for rail laying
No rail laying
Joint Gap Between Rails in Inches
-10 0 +10 20 30 40 50 60 70 80 90 100 110 120 130
Rail Temperature in Degrees Fahr.

Left—Fig. 1, Expansion Range for 78-Ft. Rail with Joint Opening Restricted to ⅜ in.

Below—Fig. 2a, Temperature Stresses in West Rail. Fig. 2b, Expansion Openings in West Rail



readings. At each end of the 20-rail test section, two rail ends were embedded on each side of the track as reference points to determine the longitudinal movement of the rail.

In taking strain-gage measurements, the test bar was placed on the base of the rail and allowed to reach the same temperature as the rail. Strain-gage readings were then taken on both the rail and the test bar and recorded, together with the temperature of the rail. A complete series of these readings was taken before the rail was placed in the track. A second series was taken after the rail was laid and surfaced. A third series was taken on July 15, at which time the atmospheric temperature was 100 deg., and that of the rail was 127 deg. It is planned to take additional readings at intervals, particularly during the coldest part of the winter.

What the Strain Gage Showed

At each series of readings after the rail was in the track, the expansion opening at each successive joint was recorded carefully, and measurement was made to determine whether longitudinal movement had occurred at the ends of the 20-rail test section. Figure 2a shows graphically the stress readings in the west rail on July 15, when it had reached a temperature of 127 deg. The variations from point to point in these readings may result in part from errors in reading the strain gage. Figure 2b shows the joint openings on the west rail at 80 deg., the temperature at which it was laid, and at 127 deg.

Between 80 deg. and 127 deg., a range of 47 deg., the joint opening, including allowance for end movement, was reduced by an average of 0.062 in. per joint. If free from restraint, the normal movement for this length of rail and temperature change would have been 0.286 in. a joint. This indicates sufficient restraint to overcome a movement of 0.224 in., which would require a restraining force of 7,200 lb. a sq. in., which is comparable with the 6,400 lb. per sq. in. measured by the strain gage. On the east rail, the average reduction in expansion opening for the same temperature range was 0.07 in., indicating an average restraint of 6,900 lb. a sq. in.

It will be noted that an average stress of 7,000 lb. per sq. in. over the rail section indicates a total restraining force of 90,000 lb., which is transmitted from one rail to the next by either joint-bar friction or abutting pressure. By reference to the chart, 2b, it will be noted that some of the joints were closed while others were not. It is evident that the joint-bar friction at the joints which had closed was less than 90,000 lb., whereas at those joints which remained open the friction must have been in excess of 90,000 lb.

The fact that the expansion openings were not closed at all of the joints indicates that the track-buckling forces will give no more difficulty in summer with this 78-ft. rail than with rail 39 ft. long. It remains to be determined whether difficulty will be experienced with bolt breakage in winter. However, the high joint resistances which have been developed thus far give favorable indication that difficulty of this nature will not occur.

Causes of Fillet Cracks*

By C. B. Bronson

Inspecting Engineer, New York Central, New York, N. Y.

WHILE we have been fortunate in that we have had relatively few cases of fillet cracks and these have been restricted as to locality, a few roads have suffered rather extensively from this type of failure. In one instance we laid rolled manganese rails containing from 10 to 15 per cent of manganese, on a curve which passed through a station platform. Throughout the length of the platform the rail was placed on a solid base and the spaces between the rails were filled with a crossing compound.

Web Cracks Developed

In the course of time it was discovered that web cracks had developed in a number of rails in the platform and that some of them had extended almost the full length of the rail, except within the limits of the joint bars. At first we thought that there might have been something faulty in the heat treatment of these rails, but experiments showed that they possessed a high degree of toughness when the head was bent back upon the web. Our studies led us finally to believe that, with the base and web held rigidly, local bending of the head occurred in such a way that the fillet between the web and head became a fulcrum and that the constant weaving or bending about this point started fine cracks which eventually developed into full horizontal splits.

Another case in which the conditions were entirely different occurred at a water pan. In this instance the track was tangent and not confined, but yielding. The joints were somewhat loose, particularly at the center of the bars, and here crosswise bending of the rail occurred. Finally, cracks started in the fillets at the end of the rails and progressed toward the end of the bars. This occurred most frequently at the receiving end of the rails involved. However, the condition was discovered before any complete failures had occurred and the bars and the damaged rails were replaced.

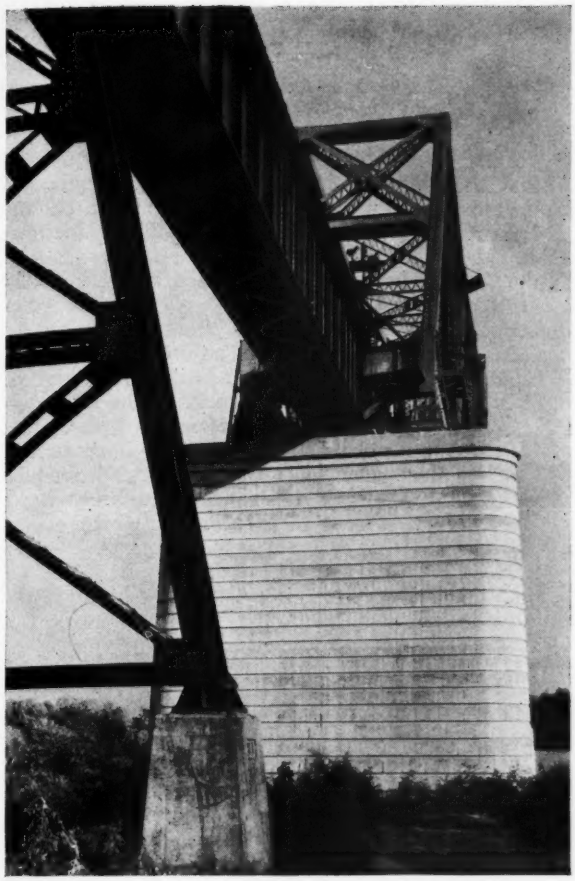
Cases of general occurrence of horizontal splits in the fillets are rather scarce. Where they have occurred there has usually been little difference in the number found in the high and low rails on curves, although where there has been a marked difference, the larger number has generally been in the high rail. In all probability this is caused by the crowding action exerted by the wheels toward the outside of the curve, which results in lateral thrust against and local bending of the rail.

No Definite Answer

Only an indefinite answer can be given to the query whether the first indications appear on the inner or outer side of the rail. While the position of the rail, that is, whether vertical or canted, has considerable influence on the place of inception, the tracking position of the wheel treads is fully as important, if not more so.

Some of the causes of fillet cracks, as explained by Professor Timoshenko, are (1) high localized stresses in the fillets, (2) lateral bending of the head of the rail about the web fillets, (3) minute surface seams which occur in all rails and (4) mechanical or mill rolling laps, although the latter seem to be of minor consequence, except in a few special cases which have come to my attention indirectly.

*This discussion was submitted for publication in the April issue as an answer to a question as to the cause of fillet cracks and the indications of their presence. Owing to its scope it was withheld for presentation here as an independent article. For further discussion of this subject see page 288 of the April issue.



Wabash Bridge over Missouri River at St. Charles, Mo.

Accidents, Deferred Maintenance Painting, Organization Rebuilding, Trestle Evolution, Building Insulation, Movable Bridge Maintenance, Protection Against Fires, Water Service Rehabilitation, among subjects considered in busy three-day convention—Unusually comprehensive exhibit.

B. & B. Men Meet in Chicago

THE forty-fourth annual convention of the American Railway Bridge and Building Association, which was held at the Hotel Stevens, Chicago, on October 19-21, reflected further recovery from the depression in the way of increased attendance, an enlarged exhibit and more active interest throughout the meeting. The program included the consideration of committee reports on The Rebuilding of our Bridge and Building Organization to Meet the Demands of the Present Day; The Maintenance of Movable Bridge Spans; Taking Up the Deferred Maintenance in Painting; Recent Developments in the Construction of Timber Trestles; Protecting Men Against Accidents in the Use of Power Tools; Practical Measures for the Protection of Bridges and Buildings Against Fire; Meeting Today's Demands for Water Service; and The Insulation of Railway Buildings.

Addresses

These reports were supplemented by addresses by C. E. Smith, vice-president-purchases, N.Y. & N.H. & H., New Haven, Conn., on The Relationship of the Purchasing and Stores Department to the Bridge and Building Department; and by S. H. Osborne, assistant to operating vice-president, U. P. System, Omaha, Neb., on Some Reasons Why Bridge and Building Men Are Injured. On Tuesday noon, S. T. Bledsoe, president, A. T. & S. F. System, spoke at a luncheon on The Railway Situation and the Part that Bridge and Building Men Can Play in Its Solution. On Tuesday evening, C. F. Goodrich, chief engineer, American Bridge Company, Pittsburgh, Pa., described the construction of the San Francisco-Oakland Bay Bridge, supplementing his address by slides and moving pictures showing in detail the erection of this outstanding structure.

On Wednesday evening, the association joined with the Bridge and Building Supply men's Association in the annual dinner. Following the adjournment of the convention on Thursday noon, the members visited the plant of the Crane Company where they had an opportunity to see the manufacture of valves and other materials used in railway water service. Approximately 175 railway men

were in attendance at the convention. All sessions were presided over by E. C. Neville, president, bridge and building master, Canadian National, Toronto, Ont.

After calling the convention to order, President Neville introduced Harry G. Taylor, chairman, Western Association of Railway Executives, who reviewed the problems now confronting railway officers and the opportunities for constructive work in associations such as the Bridge and Building Association. Greetings were extended from the American Railway Engineering Association by F. E. Morrow, first vice-president (chief engineer, C. & W.I.-Belt railways, Chicago), and from the Roadmasters Association by C. W. Baldridge, past-president (assistant engineer, A. T. & S. F., Chicago).

Election of Officers

At the closing session on Thursday morning, C. M. Burpee, research engineer, D. & H., Albany, N. Y., was advanced from first vice-president to president; F. H. Masters, assistant chief engineer, E.J. & E., Joliet, Ill., was advanced from second vice-president to first vice-president; and W. S. Lacher, managing editor, *Railway Engineering and Maintenance,* Chicago, was advanced from fourth vice-president to second vice-president. C. A. J. Richards, master carpenter, Penna., Chicago, was re-elected third vice-president; and F. H. Cramer, assistant bridge engineer, C. B. & Q., Chicago, was elected fourth vice-president. T. P. Soule, general supervisor of bridges and buildings, N.Y.C., New York, L. G. Byrd, supervisor of bridges and buildings, M. P., Popular Bluff, Mo., and Armstrong Chinn, chief engineer, Alton, Chicago, were elected directors for a two-year term. C. A. Lichty was re-elected secretary-treasurer. Chicago was selected as the convention city for 1938.

The following topics were chosen for report at the next convention:

Recent Developments in Field Methods in the Construction of Timber Trestles.

The Maintenance of Movable Bridges.

The Insulation of Railway Buildings.

The Maintenance of Cinder Pits.

The Acetylene Cutting Torch—Its Possibilities and Its Limitations.

Meeting Today's Demands with Cranes and Pile Drivers.

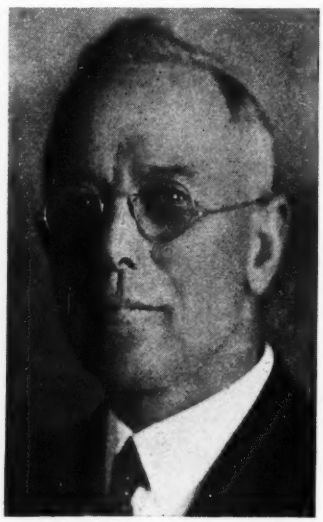
The Inspection and Preparation of Wood Surfaces for Painting.

Pipe Lines for Railway Water Service.

Abstracts of the addresses and committee reports as well as of the discussion thereon are presented below and on following pages.

Bledsoe Speaks at Annual Luncheon

One of the highlights of the convention was the annual luncheon when the members and their guests gathered to hear an address by S. T. Bledsoe, president of the Atchison, Topeka & Santa Fe system, Mr. Bledsoe being accompanied at the speakers' table by some 12 executives of Chicago railways, in addition to the officers of the association. Mr. Bledsoe's remarks, as announced by Elmer T. Howson, editor of *Railway Engineering and Maintenance,* who presented him to his audience, could be likened to a talk at a staff meeting of the supervisory officers of his own railway. In other words, it was designed to acquaint them in a forceful yet intimate way with the pertinent facts regarding the situation in which the railways now find themselves.



E. C. Neville
President

Mr. Neville is Bridge and Building Master on the Canadian National, with headquarters at Toronto, Ont. In addition to representing a large group of Canadian bridge and building men, he has long taken an active part in the affairs of the Association.

Mr. Bledsoe opened his remarks with a tribute to the long standing loyalty of the supervisory officers of American railways, adding that there has never been a time when the need for such loyalty was more urgent than today. But this is not enough, he continued. Because of the influences that are now tending to divert the loyalty of American workmen, it becomes the duty of every man who directs the work of others to show by word and action that his men can look to him for sympathetic interest in their personal problems, and that not only he but the management as well are the employee's friends.

Touching on the recent break in the prices of securities and commodities, Mr. Bledsoe declined to pose either as an accurate analyst of its causes or as a prognosticator of the trend of events in the future, although he expressed the opinion that the major disturbing influence was fear, and that this would soon be largely dispelled in-so-far as it related to business as a whole. However, with respect to the railroads, he added, their current difficulties cannot be cast aside so lightly. The railroads, he said, have no control over the prices of what they buy, and prices have markedly increased. They have also been compelled to grant increases in wages. But, while revenues have been larger this year than last, the increase in recent months has been small and the total increase, compared with last year, falls far short of making up for the forced increases in expenditures.

Expects Rate Increase

The only way out of this predicament is an adequate increase in rates, and in the light of the circumstances Mr. Bledsoe saw no reason to anticipate other than a favorable decision by the Interstate Commerce Commission on the application soon to be filed by the railroads for an increase. He expressed confidence also in the ability of the railroads to exercise the necessary discrimination in the application of any increases granted to avoid appreciable losses of traffic to competing forms of transportation. However, in his opinion the most serious aspect of the situation arises from the long interval of time between the application for and the granting of an increase in rates. Citing the experience of the English railroads in a situation such as this, he declared that whereas action in such matters in England is a matter of days, in this country as many months may elapse before a decision is reached.

In the meantime, he continued, the railroads must subsist on a restricted diet and he urged every supervisory bridge and building officer to do his part, as he has done so well in the past, to stretch every dollar to the

limit; and this, in spite of its smaller buying power. We are going to keep on fighting, he said, and with the help of our loyal and efficient staffs we are going to win in the end.

Harry G. Taylor Reviews Problems

Mr. Taylor opened his remarks by calling attention to the marked changes that have taken place in railway transportation since the last convention. Traffic, he said, started off early in the year with a promise of a well-defined increase over last year, but about the middle of the year something happened that caused it to slump and the resulting shrinkage in revenues, plus an unanticipated increase in expenses, have placed the railways in a serious predicament. The job now before the roads, he continued, is to find $600,000,000 that they must have to maintain their existence. This much is necessary for them merely to break even.

It would be wonderful if the railroads could have adequate revenues, he continued. They could spend $2,000,000,000 in the improvement of their properties without wasting a cent. This fact should be clear to anyone who rides trains and sees the evidence of under-maintenance—the need for painting, for example. An expenditure of this magnitude by the railroads would contribute more to the prosperity of the country at large than an equal outlay by any other industry because its influence would touch almost every community. I wonder why it is, he added, that politicians maintain an attitude towards the railroads that imposes such severe obstacles to the appropriation of adequate sums for the improvement and upkeep of the properties.

I am afraid that railway employees do not always realize fully how important it is that the railways be enabled to make adequate capital expenditures. As a matter of fact, there is a rather definite relation between capital investment and employment. Further than this—the amount of capital required per employee is constantly increasing. Thus in 1916, he said, the total investment in railway properties amounted to a little more than $10,000 per employee, while in 1936, it represented $26,000 per employee. It is equally important, he added, that adequate appropriation be made for upkeep, but the outlay for maintenance of way and structures in 1936 was only about half as large as the expenditure for the same purpose in 1926. The maintenance officer appreciates the extent of the deficiencies of current expenditures.

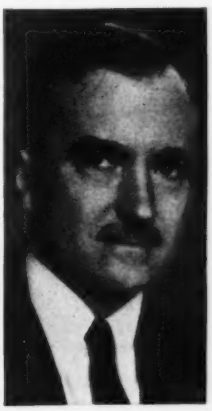
The reduction in expenditures for operation can be illustrated in another way, he continued. In 1936, the net railway operating income amounted to about $660,000,000. A search for a previous consecutive 12 months when the net railway operating income was substantially the same, discloses that this was true for the 12 months ending with August, 1931. However, the gross revenues for those 12 months were $550,000,000 more than for the year 1936, which means that the operating expenditures were less by that amount in 1936 than in the 12 months ending with August, 1931. That railroad men found ways of making that much of a saving is surely proof of the efficiency of management and of the manner in which the railroads have been able to realize on the expenditures for improvements made in pre-depression years.

In spite of the essential character of the railroads in our industrial picture, they are faced today with the gravest crisis in American history. The future of the railroads is in jeopardy today because of the enormous increases in expenditure that have been imposed on them by government action. The situation is critical; we face the specter of government ownership. The railroads must be granted an increase in rates and the heavy hand of the politician must be removed.

C. Miles Burpee
First Vice-President

F. H. Masters
Second Vice-President

C. A. J. Richards
Third Vice-President



Walter S. Lacher
Fourth Vice-President

C. A. Lichty
Secretary-Treasurer

Bridge and Building Association

Officers 1936-37

E. C. Neville, President, bridge and building master, C.N.R., Toronto, Ont.

C. M. Burpee, First Vice-President, research engineer, D. & H., Albany, N.Y.

F. H. Masters, Second Vice-President, assistant chief engineer, E.J. & E., Joliet, Ill.

C. A. J. Richards, Third Vice-President, master carpenter, Penna., Chicago.

W. S. Lacher, Fourth Vice-President, managing editor, *Railway Engineering and Maintenance*, Chicago.

C. A. Lichty, Secretary-Treasurer, Chicago.

Executive Committee

(Terms Expire October, 1937)

W. R. Roof, bridge engineer, C.G.W., Chicago.

T. P. Soule, general supervisor bridges and buildings, N.Y.C., New York.

F. H. Cramer, assistant bridge engineer, C.B. & Q., Chicago.

(Terms Expire October, 1938)

B. R. Meyers, assistant general bridge inspector, C. & N.W., Chicago.

G. S. Crites, division engineer, B. & O., Punxsutawney, Pa.

R. E. Dove, assistant engineer, C.M. & St.P. & P., Chicago.

Past President

T. H. Strate, division engineer, C.M.St. P. & P., Chicago.

President Neville's Address

In his address at the opening session President Neville expressed his appreciation to the officers and members of the association for the work they had done during the year. Turn-

ing to the broader aspects of railway transportation, Mr. Neville then referred to the increase in the volume of passenger and freight traffic that had taken place during the early part of the year, which, he said, had given the impression that the "depression is over." But he warned his audience not to be deceived by appearances, and called attention to the fact that much of the gain in traffic has been won back to the rails by improved and, therefore, more costly service. The railroads are at a disadvantage, he added, because it is impossible to curtail their services with declining business to the extent that this can be done by most other industries, with the result that reductions in expenditures at such times are focused in those departments in which retrenchment has the least immediate effect on service.

The bridge and building department has always come in this category, with the result that is is among the first to feel the effect of reduced earnings. During the recent depression its activities were curtailed progressively until they amounted to little more than running repairs, but a year or more ago the condition of the properties had reached a stage that forced the railroads to undertake extensive replacements and expanded maintenance programs. The resulting increase in the expenditures of this and other departments in the same predicament has absorbed an appreciable part of the increase in revenues, so that the railroads are still in an unfavorable position.

There is, therefore, he explained, an urgent need for the most efficient conduct of the operation of all departments, to the end that the service will continue to improve to a point where still more traffic will be recaptured from competitors. Bridge and building officers have a place in this picture, since they must do their part to see that service facilities are kept in condition to insure the most effective operation. President Neville closed his remarks by directing attention to the educational value of attendance at the association's conventions, as a means of preparing supervisory officers for greater usefulness to the properties they serve.

Taking Up the Deferred Maintenance in Painting

Report of Committee

T. P. Soule
Chairman

AFTER a careful and extensive survey of existing conditions, the committee feels that it cannot stress too strongly the vital importance of painting as a measure for protecting our structures. When it becomes necessary to reduce maintenance expenses, painting is, almost without exception, the first work to be curtailed. The reason for this appears to be the widespread belief that the chief object of painting is to improve the appearance of structures and to please the eye.

The pleasing appearance of a structure, however, is actually only a by-product of painting. The greatest value lies in the protection it gives structures from the destructive forces of the elements and from the deteriorating effects of gases, moisture, fumes and brine encountered in operating conditions. During the entire history of the railways, there has never been a time when men responsible for the maintenance of structures have been forced to curtail painting expenditures so drastically, and for such a lengthy time. Evidence is available every where that this prolonged retrenchment has been costly in actual damage to structures, entirely apart from their unsightly condition.

The October, 1936, issue of *Railway Engineering and Maintenance* contained a very frank and comprehensive article entitled "How Far Behind Is Painting?" The subject was presented after a very careful survey embracing 60 per cent of the railway mileage of Canada and the United States. The importance of the subject may be realized when it is known that the railways of these two countries are using and maintaining 370,000 buildings, representing an investment of $1,680,000,000, and 280,000 bridges valued at $2,500,000,000, or a total investment of $4,180,000,000. The article continues by showing that in normal times the maintenance of these structures, apart from any improvements, betterments or enlargements, requires the expenditure of $129,500,000 annually. With figures such as these, it becomes obvious that the importance of proper protective coatings for these structures should be given the most careful consideration before their maintenance is deferred.

This article has been most useful to the committee in the consideration, study and preparation of this report. It is urged that all members directly interested should review this article prior to a detailed study or consideration of our report, for it contains considerable material which is pertinent and was used as a groundwork for the committee's study. From observations made, the committee believes that the following conclusion presented in the article, is conservative and represents actual physical conditions which must be considered as basic before proceeding to the discussion of the subject, proper: "On the basis of the actual expenditures for painting, as compared with normal years, and of the various expedients which have been adopted to prevent or reduce deterioration in steel structures, it can be said with a considerable degree of certainty that for the country as a whole, the painting of buildings is at least five years in arrears and that the painting of bridges is not less than four years behind."

Greatest Loss

Possibly the greatest loss has been to shops and engine houses, involving particularly considerable replacement of sash, doors and frames. These building parts are most vulnerable to weathering and particularly subject to decay. In one instance of prolonged deferred painting, renewal costs of such woodwork, after 14 years' service on an engine house,

This Tank Needs Attention

amounted to $1,327, whereas the cost of puttying and painting in accordance with current unit prices would have been $65. Assuming repainting requirements on a three-year basis, the amount expended for renewal would have provided repainting for more than 60 years, or the annual interest on the replacement value, at 5 per cent, would have paid for repainting each year.

Generally, the loss occasioned to the main exterior walls of shop buildings is not as large and does not usually extend beyond minor repairs. However, such surfaces will require careful preparation and, in many instances, the complete removal of old paint films plus the use of three coats of paint, so that repainting costs will be comparatively high.

Some Examples

Records of the railroad referred to above indicate that for a period of 13 years the total maintenance expense, including labor and material, for repainting a steel bridge of 10,000 tons subject to brine and gas deterioration amounts to 51 cents per ton per year. The steel of this structure is in excellent condition. As a comparison, two other cases are presented which involve deferred paint maintenance and neglect:

(1) Steel bridge of 982 tons. During a period of 26 years inadequate paint maintenance resulted in the replacement of 583 tons of steel, at a cost of $47,000. This cost included removal of the old and placing of the new steel (without increasing the capacity of the structure) and maintain traffic. Applying the figure of 51 cents per ton per year for paint maintenance, the total amount expended over 26 years, including interest at 5 per cent, would be approximately $27,819, or $19,291 less than the amount expended for renewal alone, excluding any painting and interest charges whatever.

(2) A deck girder bridge with buckle-plate floor, covered with concrete and waterproofing over main line tracks, was subject to gases from engine exhaust in addition to ordinary atmospheric conditions. After 29 years, complete renewal was required, at a total cost of $18,500. The estimated cost for complete preservative maintenance, including interest charges at 5 per cent aggregated to about one-half this amount.

These are merely a few instances of the results of entirely inadequate maintenance. Records of all railways may disclose particular instances of expensive procrastination. They reflect the cause and effect quite clearly and are cited merely to demonstrate the cost of delayed painting which must ultimately be borne.

A Critical Study

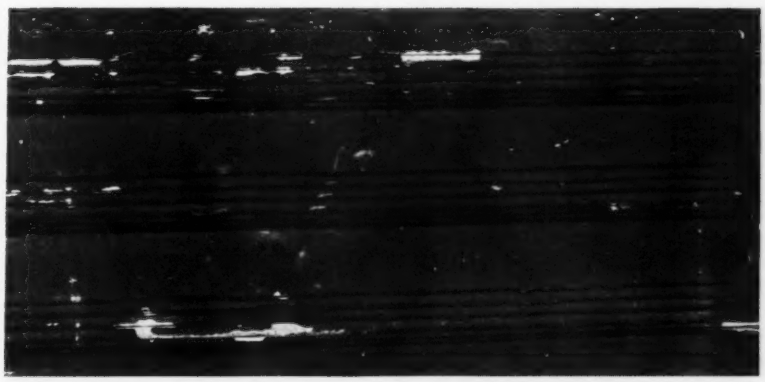
It is the opinion of the committee that a careful inspection should first be made. With improved operating conditions and better earnings, this seems to be an excellent time for undertaking a complete field survey of all structures.

After the compilation of complete detailed data, this survey should be used in an extensive investigation to determine the course of action to be taken in each individual case. During the last few years operating conditions have changed to such an extent that many structures have outlived their usefulness, and immediate abandonment may be indicated. In other instances, structures may be required for only a few more months or years. Bridges and water and coaling stations should receive similar consideration, because of changes in the design of locomotives and in the operation of trains.

This investigation is recommended because a number of cases have been disclosed to the committee in which bridge and building forces completed extensive repairs to and repainting of buildings, only to see them abandoned and demolished shortly thereafter. A small bridge on a branch line, for example, was completely replaced at an approximate cost of $25,000 less than two years before the entire line was abandoned. Adequate temporary repairs at a fraction of the cost would have sufficed, and operation for the short period could have been carried on with complete safety. Therefore, the reason for the existence and continuation of buildings and structures should be studied closely, particularly with reference to future operating possibilities, and their status in the painting program should be decided accordingly.

Should Prepare a Program

A program should be prepared, based upon this survey, showing what repairs are necessary before painting. Sufficient labor and material should be provided to take care of these repairs well in advance of painting, so that there will be no delays to the paint gangs during the painting season. While taking care of the more important structures first, the outlying structures should, so far as possible, be attended to at the same time, to avoid moving the gangs over the same territory twice. With such coordinated action, expenditures may be regulated, and comprehensive repairing and repainting programs prepared which include also complete estimated costs of the work.



An Example of Neglected Painting

Preparation of Surfaces

After the adoption of a definite program, and the completion of repairs, the proper preparation of sur-

faces for painting, and the materials chosen are of vital importance. With better conditions and more money available for maintenance, the general

This Downspout Has Lost Its Paint

tendency will be to paint as many structures as possible, merely to improve their appearance. This tendency should be curbed if we hope to bring our painting up to normal and to protect our structures. One coat of paint hurriedly applied might produce an effect that is temporarily pleasing to the eye, but it will not protect our property. Unless adequate preparations are made prior to application, no amount of new paint will prevent old, worn-out paint from scaling. A loosely adhering undercoat of paint is a distinct menace to all future paint coats.

Wood surfaces require careful inspection and preparation, especially when they have been neglected for some time. The major cost is incurred in cleaning, and it should be done thoroughly—using dusters, wire brushes, scrapers, and burning, as required. Old paint that is loose or cracked should be removed with either a paint remover or a torch. If a torch is used, care should be taken to prevent fires, and a fire extinguisher and water should be readily available. Paint which has chalked should be brushed with a wire brush to remove as much of the dry pigment as possible.

One of the most important factors is to know that the wood surface to be painted is entirely dry, for if moisture is present any paint applied is certain to blister and peel. Although such preparation adds materially to the cost, and in many instances involves the necessity for repriming the surface, it is well worth while. Halfway measures involving low initial cost may decorate the buildings temporarily but their inadequacy will be realized in the very brief intervals between repaintings, together with exorbitant cleaning costs occasioned by the removal of badly deteriorated coatings. A paint film which begins to disintegrate prior to the regular painting period will not only require costly removal measures, but also the expense of an additional priming coat. Therefore, although the accepted methods of good painting practices may involve high first costs, their true economy becomes evident over a period of a few years.

Puttying should be done after the first coat of paint has been applied and is thoroughly dry. A good putty made from pure linseed oil, white lead and whiting should be used. Every crack should be completely filled to exclude moisture. This is particularly important around sash and window frames.

Two or Even Three Coats

Under present conditions, where painting has been deferred, structures should have at least two coats and, in many cases, three coats of paint. After the surface has been thoroughly cleaned (which represents the major cost of the operation) and one coat of paint has been applied, the second coat will cost about 25 per cent of the cost of the first coat, and three coats will cost about 50 per cent more than one coat. To illustrate this point—if it should cost $1 per unit to prepare the surface and apply one coat of paint which might last one year at the most, it would cost $1.25 to apply two coats, which would probably last three years; or it would cost $1.50 per unit for three coats, which would probably last five years. Painting done in this manner will carry over a considerable period, and will materially assist in the re-establishment of a definite program of periodical repainting. Furthermore, it will insure a good surface, requiring a minimum of preparation at the next painting period.

Therefore, it would seem that if we are to bring our painting up to normal, we should plan to apply at least two coats after careful preparation of the surfaces, and when necessary three coats. This will give us an opportunity to cover our entire territory before any of the structures need repainting.

We recommend the use of modern paint spraying equipment in the application of paint. In general, this method has been found to be more economical and more satisfactory. Almost any type of paint may now be sprayed, and loss of paint by atomization is trifling. Labor costs are materially reduced by spraying, the finished appearance is equal to and often surpasses brush work, and the durability of films is equal to and often superior to that of films applied by brush.

Materials

So far as materials are concerned, the committee recommends adherence to quality products, the life, usefulness and economy of which are firmly established by adequate service records over a period of years. Although satisfactory results have been reported with the use of paints manufactured in accordance with railroad specifications, it is our firm conviction that reliable paint manufacturers whose entire resources and energy are devoted to the production of paints

Expensive Cleaning Will Be Necessary Before This Steel Can Be Repainted

and to the development of coatings that will give maximum protection on specific surfaces and under specific conditions, are in a much better position to make products that will result in better protection and, if properly applied, in considerable ultimate economy.

It is not within the scope of this report to outline painting methods in detail. However, reference is made to the proceedings of the association as follows:

"Cleaning of Steel Bridges Preparatory to Painting" (1935)
"Protecting Steel Bridges Against Brine Drippings" (1936)
"The Inspection and Maintenance of Water Tanks" (1936)

The committee has briefly reviewed the subject of deferred paint maintenance on Canadian and American railways. A few detail illustrations have been cited to illustrate the monetary losses incurred by these forced practices of the past few years. It has no means of measuring accurately and translating such losses into a sum representing the tremendous total involved. Nevertheless, it must be realized that that total would be expressed in millions. With such conditions existing and the reorganization of the forces of rehabilitation, the expenditure of millions of dollars is involved. Therefore, we recommend the institution of careful detailed surveys, the establishment of selective repair and repainting programs, the reorganization of maintenance of way painter gangs, the use of carefully selected and tried materials, together with approved and selected methods of operation and application as a long stride towards the goal of adequate protective and economic maintenance of structures.

Committee—T. P. Soule (chairman), gen. supvr. b. & b., N.Y.C., New York; C. Miles Burpee (vice-chairman), research engr., D. & H., Albany, N.Y.; C. W. Boyce, supvr. b. & b., Y. & M.V., Vicksburg, Miss.; V. S. Brokaw, asst. engr., C.M.St.P. & P., Chicago; G. S. Crites, div. engr., B. & O., Punxsutawney, Pa.; H. Cunniff, gen. for., painters, D. & H., Cohoes, N.Y.; A. D. Gillis, supvr. b. & b., N.Y.N.H. & H., Providence, R.I.; C. E. Horrom, supvr., b. & b., Alton, Bloomington, Ill.; P. F. Maisenbacher, rdm., E.J. & E., Gary, Ind.; T. D. Saunders, asst. engr., C.N.R., Toronto, Ont.; B. M. Whitehouse, gen'l. bridge insp., C. & N.W., Chicago.

Discussion

The discussion turned largely to the relative advantages of purchasing paint by brand and on railway specifications. Several members stated that their roads had been buying on specification but are now buying on brand from reputable manufacturers and are getting paint that is much superior to that which they obtained under the former practice. However, one speaker reported that there is a general painter foreman on his road who mixes his own paint and produces what he claimed was a better product than can be obtained from manufacturers.

Substitutes for painting were also discussed at some length, President Neville describing a method of applying spent crank-case oil to badly corroded bridge members. He said that this oil not only softened and loosened heavy scale but afforded protection against further corrosion for about six months. Mr. Soule described the use of heavy-asphalt-base oil for corroded steel surfaces on his road where it has given satisfactory results.

Relationship with the Purchasing and Stores Department

By C. E. SMITH
Vice-President Purchasing and Stores
New York, New Haven & Hartford, New Haven, Conn.

IT IS an unusual pleasure to address you at this annual convention for it is just 20 years since I presided as president over your annual convention at Chicago in 1917. My work has changed greatly since those days, but I find that my former bridge and building experience stands me in good stead.

I am inclined at times to review the schooling that I received in the handling of materials when I was first appointed bridge engineer of the Missouri Pacific in December, 1906. In those days this road had a special tie and timber department that was not under either the purchasing department or the bridge and building department, and whose principal aim seemed to be to get as much timber on the property as possible, regardless of the maintenance and improvement programs, the rates at which the material was to be used or the localities where particular kinds of timber were to be used.

I found more than a full year's supply for the system of 12-in. by 12-in. framed timbers stored in the low-lying, swamp country of Arkansas, where little framed timber

C. E. Smith

was used. I found in the hilly area of southwest Missouri, where the rock in creek beds prevented the use of piling, a supply of southern piles sufficient to meet the needs of the entire system for several years. Also stored in an area in Missouri where there were few timber bridges, was a supply of timber stringers adequate for the entire railroad for much more than a year.

Remembering that no creosoted timbers were used in bridge work in those days and that untreated timber deteriorated rapidly in storage, particularly in the south, you will realize what an object lesson that was to me and what a serious clash I had with this tie and timber department when I called attention to the fact that timber seemed to be stored where there happened to be room for it, rather than in the most convenient location and without regard to its use, and that much of it had decayed so badly that it could not be used. Thereafter, the bridge and building department had a controlling hand in the amount and location of its stock.

I had the opposite experience a short time ago on the New Haven when a double-track creosoted, open deck, pile trestle over the Lieutenant river, near the mouth of the Connecticut river, burned and put two tracks of our main Shore line between New York and Boston out of commission. The fire occurred just after noon on a Monday. Because lumber yards are

located on our lines at ports on the Hudson river, Long Island sound, Narragansett bay and Boston harbor, where we can secure timbers of any size readily in emergency, we do not carry in stock any more timber than is on its way to or through or from the creosoting plant for specific jobs. Of course all such material that was needed was deflected immediately to the bridge and it was pieced out by material hurriedly secured from commercial yards. There was no trouble in assembling all the framed timber at the bridge within much less than 24 hours.

Locate Piles With Difficulty

But when the bridge department called for 200 seventy foot piles we thought we were stuck. No railroad in New England or tributary to New York City had anywhere near that number of piles in stock, except some heavy Greenheart piles in New York Harbor which were too large and heavy for our pile driving equipment. Late Monday afternoon we discovered 200 seventy foot piles that had just been creosoted at a plant on the Boston & Albany for re-driving a pier at Boston. The Boston & Albany was kind enough to interrupt its driving program to let us have those piles and they were available at the ends of the bridge early Tuesday morning before the bridge and building forces were ready for them.

This experience illustrates better than anything that can be said the importance of the relationship of the purchasing and stores department to the bridge and building department. The purchasing and stores department is primarily a service of supply. It can be of service continuously to the bridge and building department by securing the right goods in the right amounts at the right places and at the right price.

Furnishing the Goods

The ability to furnish the right goods depends upon the possession of proper requisitions, proper specifications, proper inspection, reliable sources of supply, and proper handling, and storage if necessary. Having the right amounts of materials available requires a careful survey of requirements and attention to the progress of the construction and maintenance programs. Too much material long before it is needed and too little material not on hand when needed, are equally serious sins which can be avoided by close cooperation between the purchasing and stores and the bridge and building departments. Having materials in the right place is again a matter of cooperation between departments, with a knowledge of the requirements of the bridge and building dpartment.

To secure the right price, the purchasing department must have the widest possible information on sources of supply and secure currently competitive bids to discover which companies, at particular times, need orders most and are willing to ship at the lowest price. The bridge and building department can help the purchasing department by giving sufficient advance information as to its requirements to enable the purchasing department to secure and canvass bids. There is nothing quite so expensive as buying for quick shipment when insufficient time is allowed for the purchasing department to secure and canvass bids. This can not be avoided in real emergencies but should not occur in connection with regular programs.

Wide Range of Products

Purchasing for the bridge and building department comprises a very wide range of products, including all kinds of lumber, timber and piling, cement, sand, gravel, and rock, bridge and building hardware, steel bridge work, paints, and all other building materials. The preparation of proper specifications and the conduct of inspection require the most complete cooperation between the bridge and building department, the engineering and testing departments, and the purchasing and stores department. We secure the most complete specifications from the engineering and testing departments on the maximum possible number of items that can be bought through specifications.

Paints, steel work, and all other items except lumber and piling are purchased, subject to the inspection of our engineer of tests. Lumber and piling are purchased subject to inspection by inspectors working directly for the purchasing agent. We know of no other way than by specification and inspection to assure that our bridge and building forces will have materials of the proper quality. You can assist in holding costs down by keeping the purchasing and stores department advised in advance as to your requirements so that it may be in a position to take advantage of favorable prices for large orders and give shippers ample time to work on orders.

Proper cooperation between the bridge and building department and the purchasing and stores department will enable us to provide for your wants without maintaining an unnecessarily large inventory in bridge and building materials. This is particularly important because bridge and building materials are expensive to handle and store, and deteriorate rapidly in storage. Money should not be tied up unnecessarily in such materials. Impending price increases alone can justify the purchase and storage of surplus stock.

The purchasing and stores department can help the bridge and building department by having suppliers ship as much material as possible direct to the jobs, thereby avoiding unnecessary duplication of handling and expense. Carload shipments should be arranged to the maximum practicable extent, particularly when material comes over other railroads at tariff rates.

It goes without saying that company material should be unloaded promptly from foreign cars at all times and from home cars at times of car shortages. When there is a surplus of home cars, unloading may be arranged on the most economical basis.

The purchasing and stores department should provide what the bridge and building department wants unless it is clear that equal results can be secured by using other materials. No purchasing or stores department officer should arbitrarily make any substitution without consulting the bridge and building department, but the latter should be ready and willing to submerge its preferences when it is clear that substitutes will give as good results at less expense.

Keeping Costs Down

The bridge and building department can assist the purchasing and stores department and keep its costs down by making the most effective use of surplus and obsolete materials that would otherwise be unuseable or sold for scrap. The stores department should keep the bridge and building department currently informed of such materials and offer suggestions as to its use. Too much useable material gets into scrap, in spite of the efforts of the stores officer to find use for such materials. The bridge and building department is only a slight offender along these lines, but we can all be helpful in making the greatest possible use of second-hand materials, either directly or by economical reclamation. You can help also by gathering up scrap and turning it over to the stores department for handling and sale on the most favorable basis. Stores officers should keep bridge and building officers in-

formed of current material prices and particularly as to price changes affecting bridge and building projects.

Purchasing officers can be of service to bridge and building forces by making sure that they have the latest equipment in derricks, pile drivers, compressors, cranes, welding equipment and other tools necessary for the efficient conduct of the work.

The Purchases and Stores division of the Association of American Railroads has a number of committees which report each year and whose reports are published in its annual proceedings. Many of these committees work on bridge and building material problems. Their reports are of considerable value to you and you will find in them much information of interest and value to your department.

Bridge and building forces can serve themselves and their railroads by finding new ways of doing work to conserve materials and offset the rapidly increasing costs from which the railroads are now suffering. Work closely with your stores department and you will be amply repaid with the kind of service you desire.

Protecting Men Against Accident in the Use of Power Tools

Report of Committee

F. H. Cramer
Chairman

AS recently as 10 to 15 years ago few were able to foresee the possibilities inherent in the use of power tools or the changes in methods which would be necessary to secure the greatest benefits from their use. Since then, tremendous developments have taken place in both equipment and methods, which have brought a new viewpoint to those who are in charge of bridge and building work with respect to the opportunities of doing their work for less money.

During the development of these power tools, efforts were confined chiefly to the design of the power unit (either gasoline or electric), to its weight and dependability, and to the small tools best fitted for the outfit and the work they were to perform, as well as to their adaptability for general use or all-around work, not only for repairs but also for rebuilding structures. Power machines and tools were first offered as a means of easing the burden of labor, although the idea of promoting economy was also an incentive for their development. As the first power machines were being improved and while new machines were being designed to perform the work that was still being done by hand, little consideration was given to principles of safety in either their handling or operation.

Power Tools a Necessity

At present, power tools are indispensable; yet, if improperly constructed or incorrectly handled, their use will result in damage to the machines and injuries to the men. The safety movement has been fostered so intensively that most men in the ranks are safety minded. Yet there are foremen, general foremen, and supervisory officers who, because of haste or lack of attention to this important phase of their work, may be guilty of disregarding the principles of safety.

The committee believes that all power equipment and tools should be made as safe to operate as practical considerations of its use will permit. This includes the guarding of movable parts to prevent workmen from coming in contact with them; means to prevent the flying of particles dislodged from the materials or tools being handled, which may cause personal injuries; and the prevention of contact with bare wires and connections of electric circuits. It is equally important that the men who use this equipment be trained in safe methods while working with or around it.

Selection of Tools

Guarding against injuries should begin with the selection of the power tool to be purchased. We must bear in mind that the manufacturers, through necessity, will supply tools that meet the approval of the purchasers. If the buyer will specify safety as a primary consideration and economy of operation as a secondary requirement, this attitude will be reflected in the design of the tools offered by the manufacturers. On the other hand, if the man responsible for the selection of the device does not first narrow the field down to the safe tools and then from these make a choice of those that are suited to his purposes, there is apt to be a profusion of unsafe tools.

Proper Instruction

It is essential in every case where a new type has been purchased to have an agent of the manufacturer instruct the foreman and the operator in the proper functioning of the machine and, also, to make clear the necessary directions for its safe handling and care. The manner in which the machinery and tools are cared for is an important item in preventing accidents. No officer or employee should be allowed to request another employee to use defective machinery, tools or appliances of any kind. It is best to assign one man to the care of the machines and to see that they are in good order before being used. If he makes light repairs when defects are first noticed, heavy repairs will be avoided later and the accident hazard will be reduced to the minimum.

Attention should be given to insure that the air hose of pneumatic tools is in good condition. When the hose springs a leak it should be repaired by cutting out the defective portion and splicing. Tape must not be used over a bad spot. Chisels, hammers, drills and other accessories with battered or split heads should not be used, as pieces are likely to fly off and cause injuries. These imperfections should be ground off. Defective tools and appliances must be separated from those in serviceable condition and properly marked or tagged. They must be repaired promptly or else turned in for exchange. The handles of air hammers should be kept tight so that the air cushion will not be lost and the hammer shattered; set retainers or spring clips should be

used with all riveting hammers to keep the set from flying out.

Wires or cables on electric tools with worn insulation should not be taped but shortened and spliced, or replaced. The wire connections, plugs, receptacles and sockets should be checked frequently, as should also the switches. This is important with well oiled tools but is especially so when working near gasoline appli-

Power Saws Must Be Used with Care

ances. Portable electric tools should not be used in the presence of inflammable vapors or gases. It is essential to avoid the use of over-size fuses on electric power machines, as is sometimes done to permit the operation of additional tools. Where this has been done, and one or more tools are suddenly shut off, a serious flash may result as well as the fusing of metal in the event of a short circuit.

Eliminating Shocks

It is well known that operators of electric tools frequently receive severe shocks, particularly when working in damp places. This hazard can be eliminated by attaching an extra wire to the housing of the tool, taping it to the extension cord and connecting it to a ground. A ground independent of the power unit is preferable. The track rail should not be used as a ground.

Temporary repairs to any tool or unit of equipment must be replaced with the proper parts with as little delay as is possible. Repairing, cleaning or adjusting should not be undertaken while the machine is in motion. When the engine or any part of the machine develops knocks, the engine should be shut off immediately, inspected and the necessary adjustments made, because parts that are loose may fly off and cause injury. All major adjustments should be made when the machine is off the track. All bearings should be kept tight. Moving parts should be kept well oiled and in adjustment. When machines are set off the track, they should be well "in the clear" and properly supported.

As it cannot be known when an emergency will arise that will require the use of machines, it is necessary that they be kept in good working order at all times. They should be stored in the proper place on the cars when being moved to and from the job, and when not in use they should be kept locked up. When loaded on cars to be transported elsewhere, they should be braced securely to prevent movement and damage while in transit.

When filling the tanks of power machines with gasoline, the carrying can should be grounded to the fuel tank before and while gasoline is being poured. This should be done in the daytime, except in cases of emergency, and all open lights of any description—lighted pipes, cigars and cigarettes—must be kept at a safe distance. When making repairs and adjustments to machines, care must be taken to see that the metal tools do not strike the fuel tank, since this might cause a spark and ignite the vapor. When it becomes necessary to prime an engine, the ignition should be off while the priming cup is open. Fuel tanks should be drained before loading on cars for transporting to other locations. Each railroad has its own rules concerning the use of gasoline and these should be followed to the letter.

Guards

An intensive program for the safeguarding of power tools and equipment should be followed and inspections should be made frequently to assure that every unit of equipment is carefully guarded. This program should embrace all water-pumping and treating plants, coaling stations, cinder-handling plants, fuel and gasoline stations, turntables, gantry cranes, all machines in shops and enginehouses, and all roadway and construction equipment and tools, such as pile drivers, bridge and wrecking derricks, clamshell machinery, steam shovels, draglines, rail layers, concrete mixers, portable pumps, air compressors, electric power units, portable table saws and welding machines. Protection or guards should be installed on tools and equipment where they were not previously required but are deemed necessary from a safety standpoint, and all employees handling such tools and equipment should be informed of the necessity of keeping all guards in place while the tool is in motion. To do this, it is suggested that a painted sign, placed where it will be conspicuous, should give notice that all movable parts must be protected with wire screens or metal guards, painted red, and also that all guards or protections must be in place at all times when tools or machinery are in motion.

Among movable parts that were often left unguarded or only partly guarded heretofore, but which should be fully protected, are radiator fans; fan belts and pulleys; flexible couplings; drive pulleys and belts; the tops and sides of pinions and drive

Men Working Around Hoisting Equipment Must Observe Safe Practices

gears; chain and sprocket drives; fly wheels, crossheads, connecting rods and crank discs; mixing drum rollers and gears in concrete mixers; clutches and hoist drum gears on hoisting engines and other hoist equipment; worm gears; and keys or key ways at the ends of turning shafts, etc.

On tools or equipment where the operator thinks that it is necessary to have a clear view of the moving parts, the guard may be a screen of ½ in. steel wire mesh, or of smaller size on small tools. Other parts can be covered with solid sheet steel, with proper hinged door openings for inspection, oiling or greasing. So that he may understand fully what protection is required in the tools or equipment he

is using, it is advisable to furnish each operator with a typewritten list of the parts to be protected and the manner in which they should be covered.

The Men

Every employee should be required to look after and be responsible for his own safety and to exercise the utmost caution in preventing injury to himself, his fellow employees and the public. Any person accepting employment on a railroad does so with the full knowledge that certain hazards are involved in railroad operation. However, this does not relieve supervisory officers and foremen from the responsibility of seeing that these hazards are reduced to the minimum, and that the men are trained in safe practices, and of taking such measures as will insure that these practices are followed. It is also important that team work be developed to promote safety. A man who is incapable of team work should not be retained in the gang.

Some roads furnish each employee with goggles and require that they be used whenever there is danger of flying particles entering the eye. Goggles should be worn when using power saws, wood-boring machines, or other drilling machines, welding or cutting torches, pneumatic rock drills or chisels, pavement busters, riveting

An Effectively Guarded Concrete Mixer

hammers and concrete mixers. It must not be forgotten, however, that goggles should be removed occasionally and wiped thoroughly to insure clear vision. This should also be done with helmets used with welding units, not only to assure clear vision but also to remove the gas that collects within them.

Men working with power tools should be alert when the power is turned on. It is also essential that they be entirely familiar with the use of the appliances. Precautions should be taken to safeguard them from flying pieces, as well as to provide protection at places where the public passes by or under the site of the work. Screens placed at suitable locations or canvas fastened under a structure should be used to protect passers-by.

When pneumatic power is in use, the valves and connections should be checked for their fitness. When electricity is used, the connections or receptacles should be observed frequently. A firm grip should be retained on all hand tools while in use. When a tool is set down momentarily, attention should be given to see that it can do no harm if the trigger is accidentally tripped or the switch is opened. It is bad practice to hang extension cords over nails or sharp projections as this will soon fray the insulating covers.

If an air hammer becomes detached from the hose while under pressure, the hose should not be seized near the free end but should be caught as far back as can be reached and then kinked to prevent further thrashing of the end. Before disconnecting a portable pneumatic tool, the air should always be turned off at the base control valve. When using power wrenches a workman must assure himself that his wrench fits his work before turning on the power.

When working with chain hoists, signals for their operation must be understood thoroughly by all concerned. If any signal is not clear to the operator, he should ask to have it repeated before a move is made. When hooks have been applied to a load and before the signal to raise is given, workmen must be sure that the hitch is safe and that they are on the side of the load where they can avoid being hurt if it should swing out when raised.

Where men are using power tools of any type, safe and proper scaffolding, either rigid or hanging, should always be provided and when they are using rotating units they should not wear baggy, loose or torn clothing. Air hose or electric cable should be kept clear and so secured that movement of the operator will not result in tools or materials being swept off scaffolds by hose or cable, thus endangering persons directly below or in the immediate vicinity.

Supervision

It is well known that it requires proper supervision to promote safety among the men. One cannot expect to find very much regard for safe practices on the part of the men unless the foreman keeps this subject uppermost in his mind and constantly before his men. He must be constantly watching for unsafe practices and correct them before they become habits.

As already mentioned, team work among the men is necessary for harmony, efficient work and safety. The foreman should be sure that the men operating the tools are experienced in

ALL PARTS PAINTED YELLOW
MUST BE PROTECTED WITH
GUARDS PAINTED RED.
GUARDS MUST BE IN PLACE
AT ALL TIMES WHEN
MACHINERY IS IN MOTION

Guards Should Be Placed Over Fans

their use, but if they are not, they should be properly instructed and coached or else assigned to other work. He should also assign a man to the care of the tools so that no accident will happen as the result of defective equipment. He should observe how the men handle their electric extension cords or air hose so that these lines will not touch high tension lines, be laid over highways without suitable protection, or laid over the tops of rails or crossing signal and telegraph lines.

Power Units off the Track

Another item to be noted is the position of power units when removed from the track, to see if they are on substantial supports, in the clear and braced against any movement toward the rails. The foreman should see that his men have ample warning of approaching trains or vehicles and that they get off the track promptly when warned. He should endeavor so to place his men that they will have freedom of movement and will not interfere with one another. Two men should be assigned to heavy equipment, so they may alternate in its operation and avoid the fatigue that causes men to become careless.

He should carry the latest division time card and should, when possible, also obtain a train lineup from the dispatcher. He should watch to see that the rails are kept cleaned off and that no damage is done to the bonding wires.

In conclusion, the committee believes that with the proper selection of the tools, a high standard for their maintenance and alert awareness on the part of foremen and men alike as to the hazards involved in their work, accidents will be kept to the minimum. Experience has shown, however, that the inspiration for this alertness must come from above; that is, the supervision must be equally alert and constantly insistent on safe practices. Lax supervision is reflected almost immediately in laxity in the application of safe practices by the men themselves.

Committee—F. H. Cramer (chairman), asst. bridge engr., C.B. & Q., Chicago; G. E. Boyd (vice-chairman), associate editor, *Railway Engineering and Maintenance*, Chicago; R. E. Dove, asst. engr., C.M. St. P. & P., Chicago; C. R. Knowles, supvr. w.s., I.C., Chicago; W. J. Martindale, bridge for., T.H., & B., Hamilton, Ont., E. Patenaude, b. & b., mast. C.P.R., Sudbury, Ont.; E. Pharand, supt. work equip., C.N.R., Toronto, Ont.; P. B. Ransome, supvr. b. & b., C. & N.W., Madison, Wis.; C. U. Smith, harbor commission, Milwaukee, Wis.; J. L. Varker, supvr. b. & b., D. & H., Carbondale, Pa.

Discussion

The discussion was initiated by a question from the president as to the measures taken to prevent the use of defective tools, and those who commented on this point were in accord as to the necessity of insisting that foremen check the condition of tools daily and of prohibiting the use of any found to be defective. In answer to a question regarding the use of masks by men operating paint sprayers indoors, Armstrong Chinn (Alton) stated that a recent investigation made in Illinois led to the conclusion that the only device that would protect effectively against inhalation of paint fumes was a helmet supplied with outside air under pressure.

President Neville stressed the importance of positive and persistent efforts to promote safety; nothing is gained by casual attention. L. G. Byrd (M.P.) said that he had applied netting at the ends of motor car tool trays to prevent tools from sliding out, that he inspects tools whenever he visits a gang and that he is especially insistent that rules governing the wearing of goggles are observed.

T. P. Soule (N.Y.C.) outlined the practice of having a safety officer inspect every new machine purchased to insure that it meets recognized safety requirements and also instruct the men in its safe operation. L. D. Hadwen (C.M.St.P. & P. retired) endorsed the policy outlined by Mr. Soule, while H. I. Benjamin (S.P.) contended that a similar practice is equally essential in cases where tools and machines are transferred from one division to another. Released equipment should always be examined by a system equipment supervisor before it is returned to use.

In the opinion of President Neville, greater safety in the operation of appliances on the Canadian National is assured because of the plan under which the superintendent of work equipment employs and assigns the operators of the larger units in addition to assigning the machines. As these men are employed on repair work during the idle season, they are competent to make adjustments and light repairs in the field and thus keep the machines in a safer working condition.

The Insulation of Railway Buildings

Report of Committee

INSULATION of railway buildings being a new subject to this association, the committee hopes that it will be received with interest. Few railroads have given much thought to the insulation of their buildings, although industry has begun to do so. If home builders, as well as other industries, can afford to insulate their structures to reduce the fuel bill and increase the comfort of the occupants, is it not equally important that the railways do likewise with many of their buildings?

Benefits

In analyzing this subject the committee desires to present first a list of the benefits which will be derived from the thermal insulation of certain railway structures:

(A) Reduces the flow of heat from spaces of higher to those of lower temperatures.

(B) Reduces the infiltration of air, dirt and moisture.

(C) Protects buildings against noise, moisture, cold and heat.

(D) Increases the ease of maintaining the desired inside air temperature, with a reduction of drafts and dampness.

(E) Reduces the size of heating or air conditioning equipment required.

(F) Reduces the operating cost of heating or air conditioning equipment.

(G) Eliminates surface condensation.

(H) Shortens the time required to heat or cool a building.

E. L. Rankin
Chairman

(I) Certain types of insulation increase the strength of a structure.

Heat flows from a region of higher temperature to one of lower temperature. Therefore, there is always a constant leaking of heat from a room when the outside temperature is lower than the inside, and vice versa. According to available tables of heat loss, we find:

Loss through walls, floor and roof by direct filtration—40 to 60 per cent.

Loss through cracks—15 to 30 per cent.

Loss through windows and doors—20 to 30 per cent.

Insulation will reduce heat losses through walls, floors and roof, but tight construction and weatherstripping or double windows or double-paned windows are needed to decrease the loss through cracks and glass.

Weatherstripping will save 15 to 20 per cent of the fuel.

The application of ½ in. of insulation, but no weatherstripping, will save 20 to 30 per cent.

The application of ½ in. of insulation and weatherstripping will save 40 per cent.

It can be shown that the proper insulation of practically any building

is an economy measure. This applies to new as well as to existing structures.

Types of Insulation

The desirable properties of an insulating material are:

(1) That it provide effective resistance to heat.
(2) That it be resistant to any permanent deterioration by moisture.
(3) That it is fire resisting.
(4) That it does not attract insects or vermin, and resists destruction by fungi or termites.
(5) That is retains its original physical shape and volume (a fill material that settles will leave an unfilled air space and also increase its density, resulting in a lessening of its efficiency).
(6) That it should not tarnish (if of the reflective type).

No very thin material (omitting the metal foils) will provide an appreciable amount of insulation, but the insulation increases as the thickness of the material is increased, although not in the same degree. One-half inch of insulation will, for example, save 20 to 30 per cent in fuel consumption in a house where it has not been substituted for any other material, such as sheathing. Adding another half-inch will save from 30 to 40 per cent. The second ½ in. costs more than the first, and the determination of whether it is worth while to pay more for the additional protection depends entirely upon the severity of the climate. It should be noted that the real cost of an insulating material is not the cost per square foot of commercial thickness, but rather the cost per unit of insulating value of the commercial thickness.

There are many insulating materials on the market at the present time, but they may be grouped in the following classes: Rigid, flexible, fill, reflective, and glass masonry blocks.

Rigid Insulation

Insulation board, manufactured chiefly from vegetable fiber (plant and wood fiber), is produced in panels of various sizes and may be sawed and nailed. It may be used solely for insulating values, although because of its rigidity, it is generally used as a combination insulating and structural material for such purposes as outside sheathing, plaster base, or interior finish for walls and ceilings. When used as a combination insulating and structural material, less total insulation is obtained, since the replaced sheathing, lath, plaster, etc., also have some insulating value. The standard sizes are 4 ft. wide by 6 to 12 ft. long. Common thicknesses are appoximately ½ in., ¾ in., and 1 in.

Rigid insulation of the non-structural type is made of the same fibrous materials as structural insulation. It is also manufactured from cork. This is usually sold for "roof insulation" and is not intended for use where strength is needed in excess of that required to withstand handling.

Flexible Insulation

Flexible insulation material consists of a loosely-felted mat of wood fiber, hair, grass, Kopok or mineral substances, usually covered on both sides with a layer of paper or fabric. It is used solely for insulation. Its light weight and loosely matted form make it suitable for cracks around openings, etc. It comes in sizes suitable for insertion between wall studs and other framing members and for application over the edges of these members. This material comes in strips or rolls from 17 to 48 in. wide and in lengths up to 100 ft. The thickness ranges from ¼ to 2 in. Fibrous glass in blanket form is another type of flexible insulation, possessing such desirable features as stability, high electrical resistance, fire resistance and high insulating value.

Fill Insulation

Fill insulation comes in powdered, granulated or fibrous form (the latter usually in bats). The products commonly used are granulated cork, shredded vegetable fiber and powdered or fibrous minerals, such as gypsum, limestone, or other rock and slag from mineral refineries. It is

Coefficients of Heat Transfer for Various Constructions

Masonry Walls	Thickness of Masonry 8 in.	12 in.	16 in.
	Average Coefficient of Heat Transfer		
Brick, furred and plastered	0.30	0.24	0.20
Brick, furred and plastered, ½-in. insulation	0.22	0.19	0.16
Brick, furred and plastered, 1-in. insulation	0.16	0.14	0.13
Stone or concrete, furred and plastered	0.37	0.33	0.30
Stone or concrete, furred and plastered, ½-in. insulation	0.25	0.23	0.22
Stone or concrete, furred and plastered, 1-in. insulation	0.18	0.17	0.16
Stucco on tile, furred and plastered	0.26	0.22	0.19
Stucco on tile, furred and plastered, ½-in. insulation	0.20	0.17	0.15
4-in. brick veneer on tile, furred and plastered	0.24	0.20	.....
4-in. brick veneer on tile, furred and plastered, ½-in. insulation	0.18	0.16	.....
4-in. brick veneer on tile, furred and plastered, 1-in. insulation	0.14	0.13	.....

Frame Walls	No Insulation	½-in. Insulation	1-in. Insulation
Siding, sheathing, lath, plaster and studding	0.25	0.19	0.15
Brick veneer, sheathing, lath, plaster and studding	0.27	0.20	0.15
Stucco, sheathing, lath, plaster and studding	0.30	0.22	0.16

Interior Walls	No Insulation
Lath and plaster on studding, finished both sides	
Air space	0.34
Rock wool fill	0.071
½-in. insulation	0.21

	Plain	Plaster One Side	Plaster Both Sides
4-in. Tile	0.45	0.42	0.40
4-in. Brick	0.50	0.46	0.43

Concrete Floors and Ceilings	Thickness of Concrete 4 in.	6 in.	8 in.	10 in.
Plain	0.65	0.59	0.53	0.49
Plaster beneath, no flooring	0.59	0.54	0.50	0.45
Plaster beneath, floor on sleepers	0.38	0.35	0.33	0.32
Plaster beneath, tile floor	0.56	0.52	0.47	0.44
Furring and plaster beneath, no flooring	0.37	0.35	0.33	0.32
Furring and plaster beneath, floor on sleepers	0.28	0.26	0.25	0.24
Furring and plaster beneath tile floor	0.36	0.34	0.32	0.31
Concrete on ground, no flooring	1.07	0.90	0.79	0.70
Concrete on ground, floor on sleepers	0.52	0.48	0.45	0.41
Concrete on ground, tile floor	0.98	0.84	0.74	0.66

Flat Roofs With Composition Roofing	Thickness of Concrete
Concrete	2 in.	4 in.	6 in.
Plain	0.82	0.72	0.64
½-in. Insulation	0.37	0.34	0.33
1-in. Insulation	0.24	0.23	0.22
Lath and Plaster, ½-in. insulation	0.26	0.25	0.24
Lath and Plaster, 1-in. insulation	0.19	0.18	0.18

Wood	Thickness of Wood 1 in.	1½-in.	2 in.	4 in.
Plain	0.49	0.37	0.32	0.23
½-in. Insulation	0.28	0.24	0.22	0.17
1-in. Insulation	0.20	0.18	0.16	0.14
Lath and plaster, ½-in. insulation	0.21	0.19	0.17	0.14
Lath and plaster, 1-in. insulation	0.16	0.15	0.14	0.12

poured, blown or packed into the spaces between the studs, joists or rafters to fill them completely. Fill material may be obtained also in the form of "bats" made by felting mineral fibers into units several inches thick and in widths to suit requirements.

Reflective Insulation

The common form of reflective insulation is thin sheets of aluminum foil, bright on both sides. It is also applied to building papers, paper-backed wire lath and to wall board. This form of insulation functions differently from other insulating material in that it reflects the invisible heat rays which are responsible for a considerable part of the heat losses. If the reflecting surface retains its brightness, aluminum foil will reflect about 95 per cent of the radiant heat that strikes it, making not only for saving in winter, but for summer comfort as well, since the sun's heat is entirely radiant. It is agreed that, under certain conditions, foils will be attacked and decompose, and in such cases the manufacturers recommend that a high purity lacquered foil be used. Special precautions should be taken to avoid electrolysis as well as the accumulation of dust on the reflecting surfaces.

Glass Masonry Blocks

Glass blocks are hollow, partially evacuated translucent units of water-clear glass. They are suitable for uses as light transmitting walls of high thermal resistance, the thermal resistance being obtained by the 40 to 60 per cent partial vacuum within the block. The blocks can be obtained in different sizes and with a variety of face designs.

Data on Types of Insulation

Heat travels by means of three mediums:

(1) Conduction, which is the transfer of heat from molecule to molecule in materials that are in direct contact with each other. The denser the material the faster the heat travels. Hence, heat travels more readily through metals than wood, and more readily through wood than fibrous material or cloth.

(2) Convection, which is the transfer of heat by means of circulating currents, such as air currents.

(3) Radiation, which is the direct passage of heat energy through space (atmosphere or vacuum) from object to object, without molecular contact (conduction) or atmospheric movement (convection).

The table gives the average coefficient of heat transfer for various building constructions in terms of (K), the coefficient of heat transfer in B.t.u. per sq. ft. per hour per degree difference in temperature on the two sides.

With the tabular information in mind, let us discuss the types of railway buildings both existing and new, which should be insulated, such as passenger depots, office buildings, freight depots, warehouses, section houses, shop buildings, etc., or any other structure which is to be heated or cooled.

New Structures

In new construction it is relatively easy to install any one of the types of insulating material which will be best suited for the structure and afford the insulating value desired. Rigid boards in frame construction are usually applied directly to the studs and ceiling joists, while in masonry or concrete buildings they are applied to furring strips. When used as roof insulation, the boards are generally nailed to wood decks or mopped to concrete or steel, with the roofing installed over the insulation. Rigid boards are also used as interior finish without plaster, either in their natural state, or painted or decorated. This is not only an economical type of construction, but one that offers interesting and attractive decorative effects.

Flexible Materials

The flexible materials are all strictly insulating products and are not used structurally to replace other materials. They are often applied to the studs, joists and rafters and on furring strips like the board materials. The best method, however, is to place them between the studs, joists or rafters, dividing the original air space into two spaces, each of which has about the same insulating value as the original space.

Fill materials are used to fill the entire space between studs, joists, rafters or furring and are installed by being poured, blown or packed in place.

Reflective materials are usually placed as a lining for the air spaces between studs, joists, rafters or furring in such a way that they face an air space, if full advantage is to be taken of their property of reflecting heat. Their effectiveness is still further increased if several sheets are so installed as to divide the space into two or more spaces.

In existing structures the type of insulating material which may be used is restricted by the type of structure, the amount of work to be done and the desired insulating results. Rigid, flexible and reflective insulation cannot be applied to walls unless extensive remodeling is undertaken that involves the removal of the interior or exterior wall finish. However, they can be applied on or between roof rafters, attic floor joists, or, in the case of rigid boards, directly to the inside walls or ceiling. Fill materials are the logical type to use in filling spaces between studs, rafters and furring, as they can be forced under pressure through temporary openings made in the walls, floors or ceilings.

In both new and existing structures, all doors and windows in exterior walls should be weatherstripped to prevent heat loss. This is especially important if the building is to be air-conditioned.

Conclusion

The committee has attempted to show the benefits of insulation and the types of material available and has also presented some data indicating the relative value of different types of insulation, without giving the formulas, thermal data, etc., which would be necessary before an accurate analysis could be made to recommend the type of insulation for each kind of railway building.

Closely allied with insulation are acoustical correction and air-conditioning, which are not covered in this report.

The committee recommends that this subject be carried over and elaborated upon at the next convention by considering the application of the different kinds of insulation to specific types of buildings, and the relation of insulation to air-conditioning and acoustical correction.

Committee—E. L. Rankin (chairman), archt., G.C. & S.F., Galveston, Tex.; Maro Johnson (vice-chairman), prin. asst. engr., I.C., Chicago; J. E. Bird, ast. supvr. b. & b., N.Y.C., Corning, N.Y.; H. J. Crudge, bldg. engr., C.N.R., Moncton, N.B.; W. H. Harrison, b .& b. master, C.P.R., Toronto, Ont.; O. W. Stephens, supvr. b. & b., D. & H., Watervliet, N.Y.; T. H. Strate, div. engr., C.M.St.P. & P., Chicago; L. C. Winkelhaus, archt., C. & N.W., Chicago; C. W. Wright, mast. carp., L.I., Jamaica, N.Y.; G. E. Boyd, associate editor, *Railway Engineering and Maintenance*, Chicago.

Discussion

G. E. Boyd *(Railway Engineering and Maintenance)*, who read the report of the committee in the absence of Chairman E. L. Rankin (G.C. & S.F.), spoke of the importance of this subject to the railways, with their many thousands of buildings, and of the large potential savings possible through the minimizing of heat losses,

and said that the railways had lagged behind other industries in the use of insulation. He pointed out that there are definite economies in insulating many types of small railway buildings as well as many of the larger types of structures, and cited several examples which indicated that the savings effected in heating costs over a relatively short period more than offset the cost of installing the insulation. He said that one of the outstanding examples of the use of thermal insulation in railway buildings is the Cleveland Union Terminal, Cleveland, Ohio, where such insulation had been applied to more than 13 acres of exposed surfaces in the station.

J. P. Wood (P.M.) and J. H. McClure (C.N.R.) both spoke of the value of thermal insulation in reducing heating costs and cited specific examples of largely reduced fuel bills in homes which had been insulated against heat losses. C. M. Burpee (D. & H.) called attention to the fact that it was often as important to insulate buildings in the South as in the North, and said that this is true particularly wherever air conditioning is to be installed for summer cooling, in order to minimize the flow of heat into the building, with the resultant decreased cost of operating the air conditioning equipment.

Both President Neville and Mr. Boyd spoke of the value of weatherstripping and of calking all cracks around windows and doors to avoid heat losses. B. R. Meyers (C. & N. W.) said that he had been told by an architect engaged in large home development projects that he had not found it economical to insulate the side walls of homes, pointing out that approximately 75 per cent of the heat losses are through the roof. Commenting on this point, Mr. Boyd inquired whether this architect would advocate elimination of insulation from the side walls of cold-storage plants or from the sides and ends of refrigerator cars.

Standard Practice on C.N.R.

W. Walkden (C.N.R.) said that his road has been applying thermal insulation to railway buildings on its Western region for a number of years, and that the application of insulation is now standard practice for all new buildings that are to be heated. He had no records of reduced heating costs in railway buildings through insulation, but said that in his own home, he knew that the installation of thermal insulation had reduced his fuel costs approximately 40 per cent. In addition, Mr. Walkden said that it is also the practice to insulate the walls, floors and sides of outfit cars used on his region to make the cars more comfortable for the men during the winter months. He emphasized that this practice is highly desirable.

W. R. Maher (T. & N. Ont.) said that on his road the roofs or ceilings of many section dwellings had been insulated at a cost of approximately $50 per dwelling, and that while this did not save the company any money for fuel, since the employees use local wood for heating, he believed that the expenditure involved in making the section houses more comfortable and less difficult to heat, was highly worthwhile in stimulating employee good will. Mr. Maher also told of insulating two water tanks, and said that in each case the annual coal consumption for tempering the water in the winter to keep it from freezing, had been reduced from approximately 14 tons to about 6 tons.

N. D. Howard *(Railway Engineering and Maintenance)* commented upon the factor of comfort for employees; the greater efficiency of employees working under favorable conditions; and the saving in lost time of employees contracting colds in cold or drafty buildings. In this connection, he cited a case of insulating the floor of a freight office over an open freight room below, which stopped the complaint of a cold floor by many employees.

Practical Measures for the Protection of Bridges and Buildings Against Fire

Report of Committee

GENERAL fire prevention rules have been adopted by practically every railroad in the United States and Canada. These rules call for the periodic inspection of premises for the elimination of fire hazards by some designated system, division or shop officer. Every railroad employee shares the responsibility to eliminate fire hazards, and to see that fire rules are enforced and that property is properly protected. Losses by fire represent an economic waste felt by every member of a community. Insurance never covers the actual loss. Destruction of a large facility frequently means unemployment, at least until the facility is replaced and returned to service.

H. I. Benjamin
Chairman

Fire Losses

The magnitude of fire losses in the United States is best reflected by the total fire loss during 1936, which amounted to $293,357,245. Monthly losses varied from $20,000,000 to $30,000,000. During 1935, a total of 4,829 fires were reported to the Railway Fire Protection Association by 65 railroads. The causes of 2,653 of these fires were as follows:

Outside exposure	421
Lightning	215
Smoking or matches	369
Trespassers	768
Incendiary origin	64
Wrecks	46
Spontaneous ignition	142
Burning of right of way	77
Heating (stoves, etc.)	364
Acetylene or open-flame torch	131
Lighting	56

This record is far from being complete. One large road, which does not report to the association, had a total of 121 fires in 1935, with a loss of about $12 per mile of operated road. Railroad losses run between $3,000,000 and $4,000,000 annually, and are impressive enough to cause every railroad man to give serious consideration to fire prevention.

The three main items of effort in fire prevention are:

A. Preventing the inception of a fire.
B. Limiting the spread of a fire.
C. Extinguishing a fire.

The most important item in preventing the inception of a fire is "good housekeeping," "a clean house." This has probably prevented more fires than any single item of protection. By good housekeeping is meant:

1. Keep the premises clean inside and outside.

2. Keep weeds and grass cut and the ground scalped around all structures and buildings, disposing of the cut vegetation.

3. Do not permit the accumulation of odds and ends either inside or outside of buildings. There is a place for everything and everything should be in its place.

4. The storing and hanging of clothing, particularly when covered with paint or oil, should not be permitted except in well ventilated and clean lockers. These lockers should, if possible, be of steel construction.

5. Smoking should be restricted or prohibited in shop buildings. Some roads provide special locations where smoking is permitted during lunch or rest periods.

6. Provide metal containers of the self-closing type for waste and rags.

7. Provide safety cans or metal receptacles for gasoline, oil or grease.

8. Keep stoves in good condition, especially stove pipes.

9. Do not tamper with electrical fuses. When they are burned out, replace them with fuses of the same size. If fuses continue to blow out, call an electrician to correct the trouble.

10. Remove birds' nests from roofs or supports.

11. Remove cobwebs from switch boxes.

12. Do not thaw out frozen water pipes with an open flame.

13. Keep attics, basements and storage rooms for old records in a clean and neat condition.

14. Keep fire extinguishers, fire hose and water outlets free from obstruction so that they are not hidden from view or are inaccessible.

15. Keep water barrels filled and provided with water pails.

16. Keep sand barrels filled with clean dry sand and provided with scoops or shovels.

17. Every employee should familiarize himself with the location of fire alarm boxes, and all fire fighting equipment.

18. Every employee should familiarize himself with the use of all equipment.

19. Fire doors are never to be blocked and should be provided with fusible links.

20. Fire roads should never be obstructed.

An employee upon discovering a fire should first give the alarm and call for help, and then start to fight the fire. First aid in case of a fire comes from water barrels or fire extinguishers. If the fire is beyond first-aid stage, he should get a fire hose stream in action as quickly as possible.

Water Barrels

Water barrels are constructed of either wood, metal or concrete, and are equipped with covers, which are sometimes hinged to the barrels. Fire pails, one or more to each barrel, may be suspended from hooks on the side of the barrel. Many roads are still using the round-bottom type of pail, but most of them have adopted the metal cone-shaped fire bucket. The latter is less prone to be taken from isolated locations by outsiders, as, because of its shape, it cannot be used for many purposes. It also has the advantage that by holding the cone-shaped end its contents can be thrown a greater distance.

Water barrels should always be kept filled and, where freezing temperatures occur, should be protected by the addition of calcium chloride or salt, well dissolved. Calcium chloride should be dissolved in warm water in advance, as it will not dissolve if just dumped into a barrel of water.

Based on commercial (75 per cent) calcium chloride, the comparative freezing points of various solutions are as follows:

Pounds Per Gal.	Freezing Temperature, Fahrenheit
½	29 degrees above zero
1	27 degrees above zero
1½	23 degrees above zero
2	18 degrees above zero
2½	4 degrees above zero
3	zero
3½	10 degrees below zero
4	17 degrees below zero
4½	27 degrees below zero
5	40 degrees below zero
5½	52 degrees below zero

The solution of calcium chloride does not deteriorate with age. With covers properly on the barrels, very little evaporation will take place and a small amount of water added occasionally will keep the barrels filled to the level intended.

Common salt is frequently used instead of calcium chloride, and the following are the comparative freezing points for various solutions:

Pounds Per Gal.	Freezing Temperature, Fahrenheit
½	24 degrees above zero
1	18 degrees above zero
2	6 degrees above zero
3	3 degrees below zero
3½	8 degrees below zero

Fire Extinguishers

Fire extinguishers are valuable as "first aid" fire fighting equipment—to extinguish a fire before it attains too great a headway. The relative value of an extinguisher depends upon the type of fire. There are three general classes of fires:

Class A—Defined as incipient fires on which the quenching or cooling effect of quantities of water is of first importance. These fires occur in ordinary combustible materials, such as wood, paper, rubbish, etc.

Class B—Defined as incipient fires on which the blanketing or smothering effect of the extinguishing agent is of first importance. These fires occur in small quantities of rapidly burning material, such as gasoline, oil or grease, in vats or other open vessels or on floors.

Class C—Defined as incipient fires in electrical equipment, where the use of non-conducting extinguishing agents are of great importance.

The most commonly used extinguishers are:

(a) Soda-acid 1-1 2½-gal. type.
(b) Carbon dioxide type—2, 4, 7½ and 15-lb. sizes.
(c) Carbon tetrachloride—quart-size pump gun.
(d) Foam-type — 2½-gal. type.
(e) Hand pump tanks—usually 5 gal.

If the fire has progressed so far that "first aid" from barrels or fire extinguishers will not control it, and if a hydrant and hose are available, get water on from the hose as quickly as possible, carrying the nozzle of the hose as close to the fire as possible. A "spray" stream is practically useless, whereas a solid stream played so as to drench the material on fire will be effective. One good stream is more effective than several poor ones. Water pressure should not be reduced by having too many streams. Flying sparks and embers should be quickly extinguished so as not to spread the fire. If it is realized that a building or structure cannot be saved, prevent the spread of fire to adjacent buildings. In almost all cases fires have a very small beginning and can be controlled by quick action.

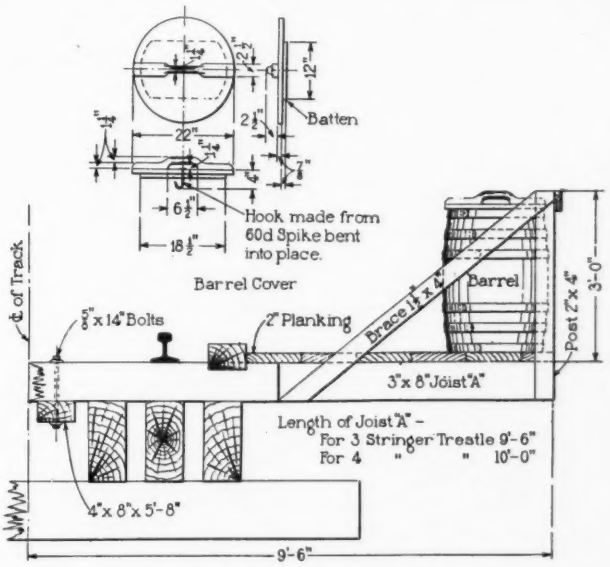
Bridge Fires

Fire destroying or damaging structures may come from a large number of causes. Fire from passing trains may be caused by live coals dropped from fire boxes, sparks from smoke stacks of locomotives, sparks from brake shoes, ignited waste from hot boxes or from a carelessly thrown cigarette. The remedies for preventing these fires are proper inspection, and the care of ash pit doors on locomotives to prevent opening enroute and rules prohibiting the opening of the door while the engine is in motion. Spark arresters or front-end netting should be part of the standard equipment on every locomotive.

The decks of bridges and open-deck trestles are extremely difficult

to protect, especially because of the almost universal use of creosoted material. Many roads cover open decks with sheet metal, which should be rust resisting. Considerable objection to this use has developed because of the cost of maintenance and the difficulty of making proper bridge inspections. It has been also found to be an obstruction in extinguishing fires starting underneath the structures.

The use of fire retardent paint has not been very successful on creosoted timber because the leaching out of creosote breaks the paint covering. On untreated floors, a heavy coat of paint upon which fine sand has been thrown, while the paint is wet, gives as good a protection as can be found. On creosoted decks the whole top of the structure can be given a heavy coating of sand or fine cinders and this will act as protection for a short time. Fire breaks should be considered on all of the longer structures so as to insure that a fire is confined to a minimum length of the structure. The use of ballast deck eliminates almost all hazard of fire from the top of the structure.



Barrel Support for Bridge Deck

Fighting Bridge Fires

To fight a fire on a bridge or trestle it is necessary to depend almost wholly upon the water barrel and the bucket. Rules covering the minimum length of spans to be protected with water barrels vary with different railroads. The longest unprotected structure is 150 ft. Above this length, one barrel should be supplied, located preferably near the abutment or bulkhead, and for each additional 75 ft., water barrels should be placed on caps or on platforms constructed at intervals. Where water barrels are placed on caps, they should be wired to the deck of the structure.

Responsibility for the maintenance of barrels and for keeping them filled with water should be definitely established and frequently inspections arranged. On many roads the section foreman is responsible for keeping the barrels filled. On the longer steel structures or viaducts, where watchmen are available it is good policy, if a water line and hose are not provided, to place fire extinguishers at intervals of about 500 ft.

One western railroad has a double-track steel structure about one mile in length, with main spans of 530 ft. each and with an untreated timber floor system, on which the following fire protection has been installed:

1. Entire wooden deck painted with a cement paint. Where ties are split and have opened up, paint has been used to fill cracks.
2. City water with a good pressure is available, and a 3-in. pipe has been run the full length of the bridge on the hand railing, with outlets for hose connections every 100 ft.
3. On each span (about 530 ft. apart) is a protected hose rack with 50 ft. of 1½-in. hose and a nozzle.
4. Three hose carts, each with 100 ft. of hose and a nozzle, are placed one at each end and one near the center of the crossing.
5. Four 10-gal. chemical carts are spaced on the structure.
6. Eight 1-gal. extinguishers are hung on the through spans in glass-front boxes, one on each span.
7. Two 1-gal. and two 1-qt. extinguishers are located in the machinery room of the lift span.
8. Two 1-qt. extinguishers are located in the operator's house.
9. Two 1-gal. extinguishers, to protect the fender work, are located one on each pier of the lift span.
10. A deck watchman with a small extinguisher patrols the bridge from end to end about every hour.

At the portals of timber-lined tunnels, in addition to water barrels, it is advisable to provide one 5-gal. fire extinguisher. This extinguisher should be placed in a box having a glass front, upon which has been stenciled "To get extinguisher, break glass." In addition, a ladder to reach the top of the tunnel should be placed at each end and should be wired and sealed.

The protection afforded snow sheds is very elaborate, with watchmen, alarm systems, special fire trains, etc. *Railway Engineering and Maintenance* has published articles on this protection, and as wooden snowsheds are limited to very few roads, the committee will not go into details.

Fire From Timber, Brush or Grass

All fire prevention rules require that debris, driftwood and trash be kept cleaned up from under and around bridges and trestles. This holds true for tunnels and snowsheds. In addition, before grass and weeds become dry they should be cut and the ground shovel-cut or scalped around abutments, and pile bents or other substructures of wood for a distance of at least 10 ft. At wooden tunnel portals, grass, weeds, brush and trees should be cut back from 50 to 100 ft. before becoming dry. Whitewashing the wooden portal and at least 50 ft. of the barrel of the tunnel before the dry season will act as a fire retardent. The dried grass, brush and trees should be burned after cutting at a time when no fire will spread. Under no conditions should a gang, burning such debris leave until every spark of fire has been put out.

On the right of way, particularly in the prairie and western territories, grass and weeds should be cut or burned at the proper time, but never during times of low humidity or high winds. Fire guards should be plowed along the fence lines where adjacent property might be damaged by a right of way fire. Plowed fire guards are, however, of no value unless they have sufficient width to prevent a fire from jumping across. A width of from 4 to 6 ft. is the minimum, depending upon adjacent conditions. Burning of right of way is usually controlled by means of wet sacks and shovels. In certain sections of the country this method has not been found satisfac-

tory and fires have escaped to adjacent property. A reliable fire-control tool for section forces is a hand-operated pump with a 5-gal. tank carried on the back of a man. Old ties should be burned as soon as they are removed from the track. New ties and timber should be protected by a covering of earth or cinders.

Facilities in Outlying Districts

Tidy condition of grounds, stations, section and bunk houses, yards and all buildings should be maintained at all times. Grass should be cut back and disposed of to a distance of at least 10 ft. from a building. Roofs and gutters should be kept clean of all leaves, birds' nests and other trash. No material of any kind should be permitted against the buildings. In freight houses, freight should be piled according to class, and all shavings, sawdust, paper, wood, etc., used for packing or any other purpose should be disposed of or kept temporarily in metal-lined boxes or bins. Sawdust or shavings should never be used for absorbing oil; sand and screenings should be used.

Stoves

Where a stove rests upon a wooden floor, there should be placed under it a metal plate, an asbestos sheet or a sand or dirt box, large enough to catch all hot coals or ashes that might drop from the stove. Stoves should, preferably, not be closer than 3 ft. from the wall, but if this is not possible, the wall should be protected by a metal or asbestos shield with an air space of at least 1 in. between the protection and the wall. Stoves should never be moved without securing permission and having a qualified man set them up properly. They should be kept clean and ashes should be removed in metal containers and disposed of in a safe place. In station buildings, etc., which are closed up for the night, fire in stoves should be put out before locking up. This rule should be modified in locations where temperatures fall below zero and where it is necessary to keep fires going continuously, even though buildings are unattended.

Stove pipe should be kept in a first class condition, renewing portions of the pipe when necessary. Joints should be riveted together or fastened in some other way and the pipe put up in a workman-like manner, securely fastened to the walls and ceilings. Pipes closer than 18 in. to the wall or ceiling should have metal or asbestos sheet protection with at least a 1-in. air space between the protection and the wall or ceiling. Metal thimbles, roof jacks or other standard devices should be used where pipes or stacks pass through wooden walls, ceilings or roofs.

Fuel should not be piled closer than three feet to a stove, without being in a fire resisting container. The bins should be metal lined and should be kept free from paper, waste, rags, chips or sawdust. The use of kerosene, gasoline or other volatiles for starting a fire or boosting it, should be strictly prohibited.

Where electricity is used fuses should be replaced in kind where necessary, and the use of pennies, nails, or wire to span a blown out fuse should not be tolerated. Drop cords, etc., should be installed by a qualified electrician.

Fill Lamps in Daylight

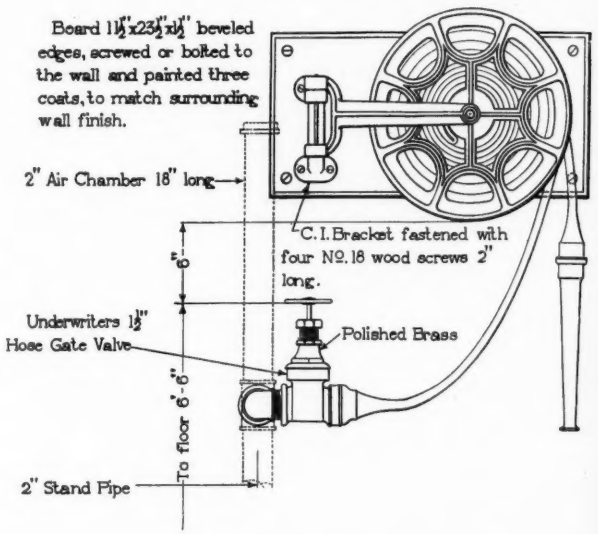
Where oil lamps are used, lamp filling should be permitted only during daylight hours. Oil wicks should be long enough to have at least one inch of their length on the bottom of the oil reservoir. Old oil wicks should be disposed of in a safe place. The supply of oil should be limited to five gallons and should be kept in a leak-proof metal can. Paper shades should not be permitted. The use of acetylene and gasoline lamps should be prohibited, and the use of kerosene lamps with glass tanks should not be permitted.

Wherever water is available at sufficient pressure to be of use, it should be piped into the more important buildings. One and one-half or 2-in. hose, equipped with nozzle, about 50 to 100 ft. in length, depending upon the size of the building, should be installed. This hose should be kept fastened to outlets, and should be placed neatly on reels or in racks and located where they can be reached in case of fire. Unlined linen hose may be used inside of a building, but as decomposition is rapid where they are exposed to moisture, hose should not be used for any other purpose than for fighting fire.

Water Barrels

In all locations, whether isolated or not, water barrels equipped with buckets should be placed outside of wooden buildings, one on each side. Where there is a wooden freight platform, one barrel should be placed on the platform proper. The agent or the occupant of the building should be responsible for keeping barrels filled at all times. If the building is used 24 hours a day, additional barrels may be provided inside of the house. It is customary to provide one barrel inside for each 1500 sq. ft. of floor space. If small quantities of oil are stored, a barrel or container of sand equipped with a shovel or scoop should be provided.

In addition to water barrels, consideration should be given to providing the more important buildings with 2½-gal. fire extinguishers of the soda-acid type where there is no freezing, or, where freezing may occur, with an extinguisher filled with a calcium chloride solution and discharged by means of a carbon dioxide gas cartridge. These extinguishers should be located near doorways in a conspicuous place and employees should be familiar with their location.


Board 1½"x23½"x½" beveled edges, screwed or bolted to the wall and painted three coats, to match surrounding wall finish.
2" Air Chamber 18" long
C. I. Bracket fastened with four No. 18 wood screws 2" long.
5'-6"
Underwriters 1½" Hose Gate Valve
Polished Brass
To floor 6'-6"
2" Stand Pipe

Fire Hose Connection and Reel

Hose and Hose Carts

At small terminals, such as engine terminals, etc., where there is always water, it is good practice to use grav-

ity tanks, washout pumps, primary pumps, etc., to bring water to yard hydrants or outlets in buildings with sufficient pressure to assure a good stream of water for fire fighting.

Hose carts in special houses should be provided with a minimum of 200 ft. of hose, 2 sharp axes, 2 nozzles, 2 lanterns, 4 spanner wrenches and 2 red flags. The length of hose is dependent upon the location of hydrants relative to the buildings, etc., to be protected.

At small as well as at large terminals, additional protection is provided if switch engines are equipped with fire-fighting apparatus consisting of at least 100 ft. of hose with a nozzle carried in a box under the running board on the tender or between tender trucks or in a rack under the roof of the cab.

Water Supply

Water mains should be laid out in a loop system, with no dead ends and with section valves so that portions of the main can be worked on without shutting off the entire supply system. Each hydrant should be provided with a cut-off valve. For this reason it is desirable that mains be "gridironed." It is important that the threads of couplings on hydrants and fire hose be made to conform with those used by the municipality.

Many terminals have grown like the proverbial "Topsy." Extensions are made from time to time as new facilities or buildings are needed. Frequently, there are no records showing the location of mains and it is only by digging around that the lines are finally located. As it is essential that water mains be kept in good condition, a record of their location should be kept. It should not be overlooked that in the case of a fire the water line will be subjected to a higher pressure than when in ordinary use, this being particularly true where standby fire pumps are provided. It is, therefore, important that occasional tests of the mains for increased pressure be made, so that when water pressure is essential to save property there will be no failure.

Regardless of whether there is an adequate railroad supply, connections should be made with municipal supplies at several points so that in case of a breakdown from any cause of the principal supply, there will be no scarcity of water with which to fight a fire. These connections should always be equipped with a gate valve, as well as a check valve to take care of conditions when fire pumps are operating and conform to public sanitary requirements.

It is not possible, in this brief report, to give all the rules for elimination of fire hazard or of fighting fire, but the committee recommends the handbook of the Railway Fire Protection Association to each railroad. This handbook is in process of revision and the new issue will probably be available this year.

What to Do

The ordinary employee cares little about what type of protection should be installed in coaling stations, cotton platforms, oil houses, round houses, etc. That is the function of the management. He is more concerned with what to do in case of a fire.

A few brief rules which should be written in capital letters are:—

1. Every employee is expected to do all in his power to protect company property.
2. Cleanliness and good housekeeping, together with carefulness, are the fundamentals in effective fire prevention work.
3. Every employee should be familiar with the location of water barrels, fire extinguishers, hose reels, hydrants and fire alarm boxes so that there will be no delay in case of fire.
4. In case of fire, the employee should—
   - A. Give an alarm from the nearest fire alarm box or in any other manner practicable.
   - B. Use every available means to extinguish the fire.
   - C. Assist the fire brigade, if necessary, when it arrives on the scene.
   - D. Report to his superior the time and place at which the fire was discovered, the cause and an estimate of the damage.
   - E. Above all else—when a fire is discovered—keep cool and act quickly.

Camp Cars

Many fires occur in outfit cars. Good housekeeping will do much to prevent this. Cleanliness, and the removal of all grass and weeds from around outfits when they are set out, are of the utmost importance. Occupants should use only safety matches and should use caution with matches, burning tobacco and other inflammable materials. No loose straw, leaves, or paper should be permitted inside of cars. Stoves for heating and ranges for cooking should not be set directly on a combustible floor, but on sheet metal or some other incombustible covering on the floor, such as approved type of sand boxes, etc., extending at least 18 in. in front and 12 in. at sides and rear of stoves. Cooking ranges should be provided with hoods of fireproof material, placed at least 9 in. below the cailing and large enough to collect all greasy vapors. Standard smoke jacks must be provided, set in a standard manner.

Gasoline Warning Sign for Signal and Section Tool Houses

The same rules should apply to installation of stoves as apply in the case of buildings.

Gasoline stoves or lights should be forbidden. Kerosene stoves should be used only in cases where special permission is granted. The same lighting rules as for buildings should govern, no gasoline lamps being allowed.

A good rule is that outfits should never be left unattended during periods when stoves are in use, or else the fires should be banked when left unattended. All outfit cars, especially cook or kitchen cars, should be inspected frequently as to cleanliness and the elimination of fire hazards.

Many roads place 2½-gal. pump tanks on walls near the doors of bunk and work cars. In kitchen cars 5-gal. pump tanks, or 2½-gal. soda-acid extinguishers, are hung in a conspicuous location where most easily available.

Coaling Stations

Mechanical coal chutes should be thoroughly cleaned at least once each month, at which time all accumulations of coal rust must be removed, especially from beams and all flat surfaces. The operator in charge should make a careful inspection each day of all bearings and electrical apparatus and observe the condition of the coal, and any defects or irregularities should be reported immediately to the proper officer. A book record

should be kept of the dates on which cleaning is done. Water should never be applied to the coal, nor should it be used for the purpose of settling dust or cleaning the chute. Smoking, as well as all open lights such as matches, torches or lamps inside of the building, should be strictly prohibited.

Coaling stations should be protected by manually controlled sprinkler systems where adequate water pressure is available. Fire hose should be placed at strategic points. One-quart carbon tetrachloride extinguishers should be placed near switchboards, motors or other electrical apparatus, or in small oil or gasoline engine rooms. Where oil or gasoline engine rooms in frame structures are heated, use a 2½-gal. foam type extinguisher; 5-gal. pump tanks should be located one in the rear of frame engine rooms and one at top of wood coal chute.

Special Requirements

Platforms for handling cotton should be protected by one water barrel and two buckets for each 375 sq. ft. of platform area, or fraction thereof, up to 1500 sq. ft. For each 500 sq. ft. in excess of 1500 sq. ft., an additional barrel with buckets should be provided.

Many railroads furnish water tank cars for fighting fires. These cars are valuable in timber territory or in shop and lumber storage yards.

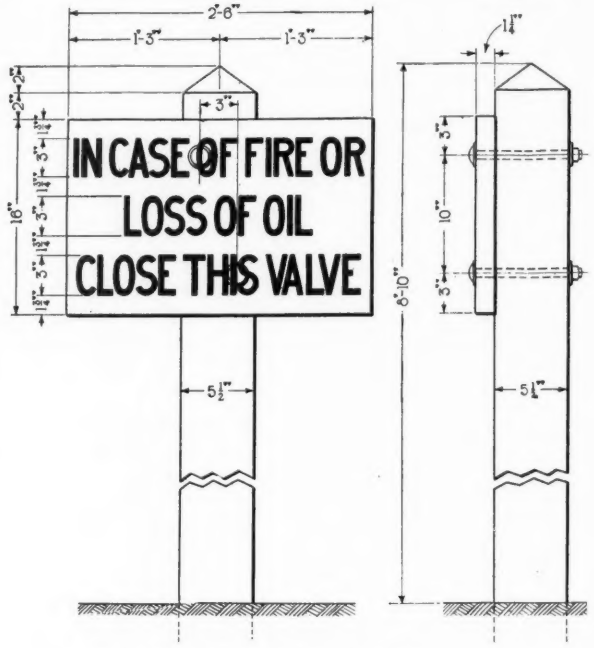
One railroad for many years equipped its locomotives with sprinklers in territory where there were numerous timber trestles. These sprinklers, connected with the tender and placed immediately under the engine cab, are opened by the engineer while passing over the structures. Dry kilns and basement storages of oil or paints are frequently protected by a manually-controlled steam jet—controlled by valves located outside of buildings.

Welding gangs and welders, particularly those occupied on track and car work, should always have a bucket of water available to extinguish small fires from their welding or building up operations.

Care must always be maintained in storing and handling gasoline both for track motor cars or in shops. Tanks are usually buried, with pumps equipped with return flow, and vents outside of tool houses. Gasoline should not be handled in an open container near a lighted lantern or any other flame, or when adjacent to a running motor. Approved safety cans should be used in shop grounds.

In conclusion, the committee recommends that, as each road has its own particular problems, the employees, particularly, in the bridge and building department, familiarize themselves with the fire rules of their respective roads, and make every effort to see that these rules are lived up to.

Committee—H. I. Benjamin (chairman), insurance com., S.P., San Francisco, Cal.; F. W. Hillman (vice-chairman), asst. engr. maint., C. & N.W., Chicago; F. R. Allen, supvr. fire prev., P.M., Detroit, Mich.; F. G. Campbell, spl. engr., E.J. & E., Joliet, Ill.; V. E. Engman, chief carp., C.M.St.P. & P., Terre Haute, Ind.; C. S. Heritage, bridge engr., K.C.S., Kansas City, Mo.; H. G. Johnson, asst. engr., C.M.St.P. & P., Chicago; W. V. Kerns, asst. supvr. b. & b., C. & N.W., Chicago; A. L. McCloy, supvr. b. & b., P.M., Saginaw, Mich.; P. J. Matheson, asst. engr., C.N.R., Toronto, Ont.; H. E. Thompson, supr. b. & b., D. & H., Oneonta, N.Y.; T. B. Turnbull, supvr. b. & b., Ann Arbor, Owosso, Mich.



Notice for Closing Fuel Oil Valves

Discussion

The report, because of its thoroughness and broad scope, created wide interest among the members, a number of whom told of specific instances of fires and fire hazards, and of measures adopted to minimize the fire losses on their roads. Armstrong Chinn (Alton) commended the report highly and then told of a serious dust explosion that had occurred in a grain elevator as the result of a power shaft belt slipping from its pulley and rubbing against adjacent timber. He said also that his road had found that the dusting of dry cement over the tops of freshly creosoted bridge and trestle ties highly effective as a fire retardant. The dry cement, he explained, mixing with the free creosote, produces a hard cake over the tops of the ties, which will not burn, and which is rather permanent in its effectiveness.

Chairman Benjamin said that on his road, where there are many miles of creosoted timber trestles, it is the practice to coat the tops of freshly creosoted deck ties with a cement paint. This paint, he said, not only produces a fire retardant crust on the ties, but also fills all cracks where sparks might lodge and ignite the timber or creosote. Continuing, Mr. Benjamin spoke of the seriousness of creosoted timber fires and of the difficulty of extinguishing such fires, and then discussed the extensive problem which confronts a road such as his with so many timber structures, most of which are so far from points of habitation that fires cannot usually be detected quickly and fought with adequate equipment. In this connection, he recalled two trestle burn-outs which caused serious train accidents.

Turning to the destruction of cars by fire, Mr. Benjamin said that this had become a serious problem on his road, most of the fires being caused by trespassers using stored cars for shelter. In combatting this loss, he said that the doors of all stored cars on his road are now wired shut with old signal circuit bond wires, an expedient which has proved most effective in discouraging trespassers and in reducing car fire losses.

Reverting to the subject of the protection of creosoted ties on bridges

and trestles, J. S. Smith (L.V.) said that his road had found a mixture of cement and sand an effective and permanent fire retardant. He said that, using a long, narrow hand screen, a mixture of equal parts of sand and cement was sifted over the tops of all newly creosoted ties, in new construction and in replacements.

In reply to a question raised by W. Walkden (C.N.R.), Chairman Benjamin discussed various types of fire breaks for timber trestles, and their spacing. He said that concrete and metal breaks are used on his road, and that they are made a little wider than the trestle bents, and extend up to the bases of the track rail.

Rebuilding Our Bridge and Building Organization to Meet the Demands of the Present Day

Report of Committee

THE subject assigned to this committee does not imply that our bridge and building organization of the past was improper or wrong for the conditions as they then existed, but it does mean that present day trends in railroading require some readjustments in our methods of doing things if we are going to keep pace with changing conditions. In the past bridge and building work was largely concerned with the construction of new lines, the double-tracking of existing lines and the replacement of temporary structures with permanent ones. While some work of this character is still being done in connection with grade separations, line revisions and the building of permanent structures, the picture has nevertheless changed and the principal work of the bridge and building department is now the maintenance and improvement of existing structures. With these thoughts in mind, and remembering that anything that affects bridge and building work will also affect the organization that does the work, it appears that any study looking toward the rebuilding of our bridge and building organization, should be divided into two parts, namely, factors that affect bridge and building work, and factors that should be considered in rebuilding our bridge and building organization to meet present conditions.

Armstrong Chinn
Chairman

Factors that Affect the Work

Probably nothing has had more affect on bridge and building work than the change in the earning capacity of the railroads, brought about by growing competition from other forms of transportation and by changing economic conditions. Competition has taken away a good share of the business and has also brought about generally lower rates for what is left. Changing economic conditions have resulted in higher wages and increased taxes and material costs so that less of the money now earned by the railroads is available for maintenance and improvements. This is clearly shown by the following table of total operating revenues and maintenance of way expenses for Class I railroads for the years 1929-1936, inclusive:

Year	Operating Revenue (Millions)	Maintenance of Way Including Structures (Millions)	Per Cent	Maintenance of Structures (Millions)	Per Cent
1929	$6,280	$855	13.6	$137	2.2
1930	5,281	705	13.3	110	2.1
1931	4,188	531	12.7	77	1.8
1932	3,127	351	11.2	48	1.5
1933	3,095	322	10.4	46	1.5
1934	3,272	365	11.2	56	1.7
1935	3,452	394	11.4	62	1.8
1936	4,053	455	11.3		

It will be noted that, along with the decrease in earnings, the ratio of the outlay for the maintenance of structures to operating revenues has also decreased, so that expenditures for this purpose are now approximately half of what they were in 1929, and bridge and building forces have been reduced accordingly. The less money there is to spend, the greater the proportion that must be spent for materials, and, therefore, the greater the necessity for ever-increasing efficiency in the use of labor.

At first glance this may seem discouraging but in reality it is an incentive to the initiative and resourcefulness of our supervisory forces. They have met the challenge and have adequately maintained our structures in spite of this greatly decreased allowance. This has been done by the more careful and thorough study of all problems to find the best and most economical solutions, the building up of gangs to the highest state of efficiency, the introduction of labor-saving tools and machinery and the programming of work to eliminate lost time, both on the job and in moving gangs over their territories. But, after all, this is progress, because we are learning, through the pressure of circumstances, to do things better and more cheaply than ever before and in ways not thought of a few years ago.

The large reduction in bridge and building forces during the last ten or twenty years, especially the last ten years, has been made possible and, in a large measure offset, by the introduction of labor-saving tools and equipment. Without these aids to better, cheaper and faster work it would not have been possible to have maintained our structures to the required standards with our present forces. The use of self-propelled pile drivers and cranes, power pile pullers, steam hammers, jack hammers and concrete busters, power saws and augers, portable air compressors and electric generators, motor cars, portable gasoline-driven pumps, arc welding, oxy-acetylene welding and burning, and special pipe boring and jacking outfits have all contributed to the speed, quality and economy with which work can now be done. To get the greatest efficiency from labor-saving equipment it must be operated by men who are carefully trained and capable of

handling it skilfully. To retain these men, working and living conditions must be made as attractive as possible and the policy of reducing forces near the end of the year should be curtailed as much as possible. It is expensive to train new men and for that reason the trained personnel should be kept intact if conditions will permit.

Improved Prosperity

It may be well to point out here that in spite of competition and increased taxes, the railroads are now entering a period of improved prosperity. How long it will last or what may follow no one knows, but while it does last our bridge and building department should take advantage of the opportunity and improve its methods and organization to the end that our structures will be maintained and improved at the lowest unit costs and be made ready to pass again through a period of restricted maintenance. Some economists predict that this period will arrive in 1940 but, whenever it comes, we should be ready for it.

Marked reductions in bridge and building forces and expenditures have been accomplished by the building of permanent structures to reduce maintenance. In this connection the committee's attention was directed to a long division on a large western road where the replacement of temporary wooden bridges with concrete and steel structures permitted 14 out of 15 maintenance gangs to be laid off and the one remaining gang to be used occasionally on an adjoining division. This is an extreme case, but shows what may be done. On the other hand it is pointed out that many roads are finding more maintenance on so-called permanent structures than was originally anticipated, particularly on concrete structures. One effect of this reduction in the number of gangs has been the elimination, to some extent, of specialized gangs. On many divisions there is no longer sufficient special work, such as pile driving or concrete construction, to keep specialized gangs busy and the work is now done by the remaining gangs which handle work of all classifications. This requires well trained and versatile men who are adept at all phases of bridge maintenance, and this has resulted in generally better work being done.

High-Speed Trains

During the last few years our bridge and building men have been faced with a new condition in railroading, brought about by the high speeds of some of our passenger trains and the generally increased speeds and faster schedules of all trains. In some instances, particularly on branch lines, this has been aggravated by the introduction of heavier power to replace old light power that has worn out. The faster trains and heavier locomotives are causing more maintenance on many bridges, some of which are already stressed to the limit. This calls for a thorough study by each supervisor of all of the bridges on his territory to determine what is required in the way of strengthening, repairs or replacement at each structure. This applies to the substructures as well as to the superstructures, as it has been found that the greater impact induced by the higher speeds and heavier loads is having an effect on piers and abutments, requiring some to be jacketed and a few to be replaced. The net result is that our bridges must now be kept in a higher state of maintenance to carry the greater stresses caused by the higher speeds and to avoid slow orders which are now, with the present fast schedules, a greater burden than ever. The necessity for eliminating slow orders or raising the speed of those that cannot be avoided, has a direct bearing on present-day methods of planning bridge work. Whenever possible, work must be handled without slow orders, and when this is not possible, it must be handled expeditiously so that slow orders can be removed promptly. This calls for ingenuity and resourcefulness on the part of the supervisors who, after all, must plan the field work for each job.

Abraham Lincoln, Chicago-St. Louis Streamliner of the Alton

Heavier Locomotives

Larger and heavier locomotives are being built for some roads, necessitating the extension or replacement of turntables, the extension of roundhouses and the adjustment of water and fueling stations to accommodate them. The larger tenders, with greater fuel and water capacities, will, in time, permit a reduction in the number of fueling plants and water stations. This is all work in which the bridge and building department is vitally interested and in which it can, by careful study and planning, make substantial savings.

The introduction of splendid new trains that are modern in every respect and the last word in comfort and convenience, should induce the railroads to improve and modernize passenger stations and other buildings used by the public, so that these buildings will be more nearly in accord in appearance, comfort and convenience, with these fine new trains. The public will demand these improvements and it will be necessary for the railroads to provide them if they are to maintain the prestige they have gained with their new trains. To some extent these improvements will be justified by good advertising. On many roads the majority of the station buildings were built to some mediaeval standard, usually with high peaked roofs and overhanging canopies supported by ornate brackets. Such structures are out of harmony with current trends in building design and are rarely objects of civic pride. Needless to say, the work of modernizing such structures at a reasonable expense will take a great deal of skill and study on the part of the architects and the bridge and building supervisory staffs.

Rebuilding the Organization

With this picture of conditions now confronting the bridge and building department we are in position to consider what should be done to rebuild its organization.

Few people realize the huge investment made by the railroads for bridges and buildings. According to the Railway Engineering and Main-

tenance Encyclopedia this amounts to $4,180,000,000 of which $2,500,000,000 is for bridges and $1,680,000,000 is for buildings. This is a tremendous investment to have scattered all over the country, and an adequate and competent supervisory force is needed to inspect, maintain and protect it. The men of this supervisory force may be termed the guardians who, while maintaining the safety of these structures, stand between the cost of labor and material and the treasury. In normal times the annual cost of maintaining and improving our bridges and buildings runs well over $100,000,000. If our supervisory forces can, by careful and intelligent planning and the use of labor-saving equipment, reduce this cost by 10 per cent, they will make an annual saving of $10,000,000, which is a very substantial sum, even in these days when we are accustomed to figures of astronomical proportions, and is enough to pay the annual salaries of approximately 3,000 bridge and building supervisors, or about five times as many as there are on our railroads today.

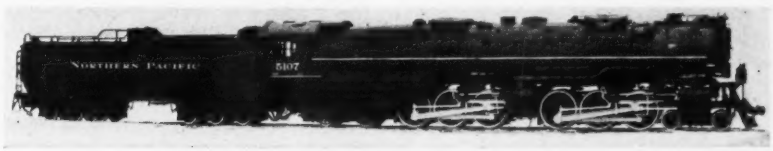
The desirability of adequate supervision cannot be overstressed. It is one of the most valuable assets a railroad can have because the economy with which any work is done depends on the kind and frequency of the supervision given it. Supervision can be, and sometimes is, spread so thin that it becomes a liability instead of an asset. This is the case when a supervisor is given so much territory that he spends most of his time riding around instead of supervising the details of his work. A supervisor should not have more territory than he can cover often enough to know personally all conditions on it. Efficiency demands that the supervisor appear personally on the job where he can see that the work is being carried out according to plans and instructions, that materials are being used properly and economically, and that power tools and labor-saving equipment are being utilized to the fullest extent. He must appear often enough to take up the loose ends, prevent waste and direct each project from start to finish. Whenever a supervisor's territory is so large that he cannot do this his railroad is not getting the return it should on the money it spends for his salary.

Provide Enough Supervision

During the recent depression, bridge and building forces were greatly reduced and on some roads the supervisors were taken off and their work put under the division engineers. The division engineers must necessarily give the major portion of their time to the track and the track gangs and to their many other duties, and for that reason each division or territory having not less than five bridge and building gangs should have a supervisor, reporting to the division engineer, whose duty it is to inspect the structures on his territory, organize the gangs, and look after the details of the work.

Some roads, in an effort to reduce bridge and building supervision, have concentrated it at centralized points, such as district, zone or system headquarters. The desirability of this is questionable. No supervisor can function at his best if he has to spend too much time traveling long distances, as this will keep him away from the work too much and he will not be as likely to have the same keen personal interest in it as the man who is located close enough to the various jobs to be held strictly accountable for all of their details. The supervisor must do more than observe and inspect, he must direct. On large systems it is felt that best results will be obtained if the supervisor is located at division headquarters where he can keep in close touch with his work. On some small roads, with relatively short mileage and system headquarters conveniently located with respect to all parts of the lines, centralization of supervision at the system headquarters of the road may be justified.

Reduction of forces, centralization of supervision and the consolidating of gangs were chiefly depression measures. However the depression is now over and depression measures are no longer needed. The present condition of most railroads will be their normal condition for some years to come and an adjustment to the present normal basis is in order. This is being done on some railroads through the restoration of divisions that were previously consolidated.



Heavier Locomotives Impose Serious Problems

The Problem of Personnel

During the lean years, when forces were being reduced, the junior men in the gangs were laid off and no new men were taken on. In the meantime many of the older men who remained have died, reached retirement age or have otherwise left the service, so that the problem of rebuilding our gangs has two aspects, that of replacing the older men who have dropped out and of hiring additional men for those gangs that are being enlarged or restored.

What type of men should be selected to build up these gangs? First, we must recognize that every man that is placed in a bridge and building gang is a potential foreman or supervisor and should be selected accordingly. A hit or miss policy of taking on new men should be avoided.

Employment in the bridge and building department of a railroad, particularly for those who have reached the rank of foreman or supervisor, is usually steady and pays well, and therefore offers an opportunity for ambitious young men who have a fair education. A bridge and building foreman, with his authority and his regular income, is a man of standing in the small towns where he is usually located on most railroads, and commands the respect and esteem of the young men who are reaching employment age. For that reason, such towns and the surrounding territories are good sources from which to recruit new employees, as they will probably be already railroad minded

Personnel Comprises the Primary Problem

to a certain extent and ambitious and willing to work in the hope of being promoted eventually to the coveted position of foreman.

Wanted, an Employment Policy

Few railroads have a well-defined policy for the selection and training of bridge and building employees and, so far as is known, no such general policy is in effect in any section of the country. It would be a good thing if a general plan were evolved for a systematic procedure in hiring new men and advancing them as they acquire the necessary knowledge and ability. It would give the new men coming into the organization something definite toward which they could work and some means of measuring their success or failure.

In rebuilding our bridge and building organization we should first give consideration to the recruiting of good men. They should be selected with the thought that they are going to stay with the organization and be promoted later to foremen, and for that reason they should be carefully selected in the beginning.

The extent to which desirable new men can be drawn into the service will depend, to a large degree, on the inducements that can be offered them. One of these inducements should be that the foremen should always be promoted from the gangs. Likewise, the supervisors or master carpenters should be promoted from the foremen. In this connection, most railroads have agreements with their employees and these agreements provide that seniority shall be given consideration in promoting men.

What Qualifications?

A new employee should be a man of good character. He should have a sound sense of honesty and justice, and the ability to associate pleasantly with his fellow employees and with the public. If he does not have these characteristics, he will be more of a liability than an asset to his company.

A reasonable education is desirable and the new employee should have at least a high school education or its equivalent. He should understand the duties of citizenship and his obligations to his fellow man. It has been suggested that it would be desirable to have a few young college graduates in our gangs who are willing to start at the bottom and acquire the practical as well as the theoretical knowledge of bridge and building work.

No applicant should be employed who does not have reasonably good health. Most railroads now make it a requirement that every applicant be examined by a physician who must pass on his physical fitness before he is permitted to go to work.

Bring Out Best Qualities

The training of the new employee should start when he is placed in the gang. As it is hoped and expected that he will eventually become a leader,

Substructures Often Need Attention

his training should be along those lines that will assist him in developing the necessary characteristics. It has been said that the qualities of a good leader are three; namely, knowledge of the work, confidence in his ability to perform it, and determination or energy to accomplish it. A fourth may be added—initiative or the ability to analyze a new or unusual situation and do the right thing at the right time. The men in the gangs should be given the opportunity to develop these characteristics, and as they do, the foremen and supervisor can take note of their other qualities, such as their ability to work safely, their loyalty to the company and their personal dispositions. Any organization is better off if it is made up of happy men, as one man with a bad disposition can spoil the morale of a whole gang.

One of the most important qualities is loyalty. It is one that we see displayed so often on our railroads during derailments, floods and snow storms, when men work strenuously for long hours to clear the tracks so that traffic may move. It is a part of the service the railroads offer the public, and is one of the reasons for the railroads' good standing with the public they serve. If an employee does not have a sense of loyalty to his company he ought to leave it and join some other organization toward which he will have a more kindly feeling.

No quality is more important than the ability to work safely. Our railroads have made an outstanding record in safety, which is, after all, the result of the combined efforts of the men engaged in running them. Every employee should, for the protection of himself, his fellow workers and the patrons of his railroad, be willing to observe the requisites for safety. Any employee not so inclined should be dropped from the service.

Watch the Candidates

It would be well for the supervisor to keep a list of the men in the various gangs under his jurisdiction who show promise of developing into foremen. This list should be revised from time to time and the names of those dropped from it who have shown that they do not have the necessary qualifications to handle the responsibilities that rest with a foreman.

As these prospects develop and the opportunity offers, they should be given a chance to demonstrate their ability on more advanced jobs, such as temporary inspector or relief foreman. During these periods the supervisor can examine and instruct them in greater detail as a means of furthering their development. When it is certain that a man has the necessary qualifications to become a foreman the division engineer, as well as the supervisor, should have informal talks with him and suggest courses of study and other means of preparing himself for promotion.

Men cannot always be advanced as soon as they are prepared for it, but this should be done just as soon thereafter as an opportunity offers, because when a man has prepared himself for promotion and it is too long in coming he sometimes becomes discouraged.

When To Promote

No definite rule can be laid down for the duration of the training period, as the answer is influenced by many variables, such as the characteristics of the man and the type of work being done. However, it would be desirable if each road would adopt a definite policy and put it in written form so that all could understand it.

Another help to the ambitious young man who wants to get ahead, is found in the current magazines and books on railway maintenance, and in correspondence courses that are offered by several schools. After a man

had advanced to a supervisory position he will find it helpful to join the American Railway Bridge and Building Association and work with the committees that are constantly studying new problems.

There has been no fundamental change in our methods of maintaining our bridges and buildings or in the organization through which the work is done. However, new conditions have arisen that make it necessary to provide more comfortable, faster and safer transportation than ever before if our railroads are to hold their leadership in the transportation field. But because of increased taxes and other costs, this improved transportation must be produced with less money. This requires intelligent and resourceful men, who know how to plan and handle their work so as to get it done to present-day standards and yet stay within the appropriation. By carefully selecting and training its men, the bridge and building department should have no trouble in fulfilling these requirements.

Committee—Armstrong Chinn (chairman), chief engr., Alton, Chicago; F. E. Weise (vice-chairman), chief clerk engr. dept., C.M. St. P. & P., Chicago; W. A. Batey, syst. bridge insp., U.P., Omaha, Neb.; R. W. Cook, gen. bridge insp., S.A.L., Norfolk, Va.; A. S. Krefting, asst. engr., St. P.M. & S.S.M., Minneapolis, Minn.; W. J. H. Manning, div. eng., D. & H., Plattsburg, N.Y.; B. R. Meyers, asst. engr., C. & N.W., Sioux City, Iowa; P. C. Newbegin, chief engr., B. & A., Houlton, Me.; T. W. Pinard, engr. b. & b., Penna., New York; A. A. Riley, supvr. struct., S.P., Houston, Tex.; G. L. Sitton, chief engr. m. of w. & s., Sou., Charlotte, N.C.

Discussion

C. M. Burpee (D. & H.) endorsed the position taken by the committee with respect to the desirability of stabilizing forces and expressed the opinion that the extent to which it is possible to insure a reasonable continuity of employment will determine in large measure the success of any efforts to recruit new men of a caliber that can be trained to become efficient workmen and likely candidates for foremen. In offering this comment, he conceded the difficulty of carrying out any such plan, but added that every effort should be made in the direction of stabilization. He also urged that new employees be given careful attention to insure that none is retained in the service long enough to secure seniority rights unless he has demonstrated that he is qualified to become a competent and efficient workman.

In answer to a recital of unfortunate experiences with mechanics hired to fill out bridge gangs, offered by one of the members, Mr. Chinn reiterated the position taken in the report that it is better to employ and train ambitious young men than to hire men who claim to be experienced bridge men. He contended also that deaths and retirements among the older men should afford opportunity to increase the proportion of younger men in the gangs. T. P. Soule (N.Y.C.) declared that it was up to the bridge and building officers to train capable men in spite of the obstacles imposed.

M. M. Killen (G.C. & S.F.) offered the suggestion that supervisors compile lists of men that would be desirable employes, and consult such lists when men are needed, stating that he had used this plan to good effect when he was identified with track work, but saw no reason why it should not work equally well in recruiting bridge men. H. I. Benjamin (S.P.) suggested that this plan might work well in settled country but that it was not practical in parts of the West where the population is sparse and men must be hired in urban centers far from the work.

The Maintenance of Movable Bridges

Report of Committee

J. L. Vogel
Chairman

THE maintenance of movable bridge spans resolves itself into three parts, i.e., the substructure, the main steel superstructure, and the machinery and its support. This report deals primarily with the latter, which includes the machinery, power unit, interlocking and other features not found in fixed bridges. In order that the committee might approach this subject in a practical manner, it was decided to send a brief questionnaire to many of the railroad companies, covering the essential items that would aid in formulating the practices used today in the maintenance of movable bridge spans.

This questionnaire consisted of eight main questions, several of which were divided into sub-questions. These questions were as follows:

(1) The number and kind of spans opened at least once a year, together with kind of power, whether electrical, gas, steam, or hand.

(2) Principal troubles encountered due to breakage or wear of moving parts, with causes and remedies.

(3) A request for a copy of instructions for maintenance, including lubrication, for the different types.

(4) The necessity for renewing:

(a) center disc of center bearing swing spans,

(b) bushings of trunnions in lift or bascule spans,

(c) balance or drum wheels in swing spans.

Also with respect to "a" and "b," how many years service or approximately the number of openings prior tho renewal?

(5) Operating personnel, the departments from which the operators are taken and their duties.

(6) Inspection of machinery, by what department and when is such inspection made?

(7) What department maintains machinery and how are repairs handled?

(8) The winter practice in maintenance (from approximately December 1 to March 1), giving the number of spans that do not operate in winter time? Where operators are removed, are lift rails replaced with continuous rails; are ends blocked up to be immovable and what other precautions are taken?

As returns were received from only 18 railroads, only a fair opinion can be formed from the information received. The answers received to Question 1 showed that, of 113 swing spans, 44 are operated electrically, 23 by gasoline engine, 5 by steam and 31 manually; of 16 lifts spans, 9 have electric power and 7 gasoline; and of 27 bascule spans, 24 are operated by electric motors and 3 by hand.

Little Trouble With Gears

In the answers to Question 2, little trouble was reported except where gears, racks, balance and rollers were made of cast iron or an inferior grade of material. This trouble was overcome by better design, and replacement with a better grade of material.

Replies to Question 3 indicated that only a few railroads have definite sets of printed rules for the maintenance and lubrication of the different types of spans.

In replying to Question 4 only three cases were reported; one covering the renewal of the disc on a draw span, another the renewal of bushings for a bascule span and a third covering the need for correcting the bottom tread and rollers of a rim-bearing draw span.

From the replies received to Question 5, the operating personnel except on a few railroads, is taken from the bridge and building department. In the other cases the men are recruited from the maintenance of way, signal and operating departments. The duties performed by the operators are similar in most cases and embrace operation, lubrication, a record of the passage of boats and attending to the navigation lights. Some also are required to keep records of water levels.

Who Makes Inspection?

In answer to Question 6, the inspection of machinery, etc., except on a few railroads, is made by members from the bridge and building department. In the other cases the inspection is made by the mechanical department and division engineers. Inspection in most cases is done on routine bridge inspection trips, except when conditions are such as to demand special trips.

According to the replies received to Question 7, the bridge and building department looks after maintenance and makes repairs, except on a few of the railroads where the mechanical department, or the mechanical department in conjunction with the bridge and building department, maintains and make repairs to the equipment.

Replies received to Question 8 regarding winter practice in maintenance indicate that most railroads maintain and keep the bridges ready for operation in winter. In cases where navigation ceases for the winter season, the lift rails are removed and continuous rails are installed. Some bridges are blocked and others are not.

From the brief summary of the replies to the various items of the questionnaire, it is quite evident that no uniform practice is followed by the various railroads replying—each railroad following methods which seem most suitable for its purpose. This very fact indicates the necessity of formulating rules for the inspection and maintenance of movable bridges which can be applied uniformly to the various types of movabe spans so that the inspector will have definite instructions which he can follow on his inspection. Each type of movable bridge has various details that require specific attention by virtue of the type of operation, and the rules could very well start by calling attention to such points of inspection, followed by information concerning the type of maintenance required to maintain these in working order.

The work of formulating rules for the inspection and maintenance of such bridges will require considerable time on the part of the committee and will be entirely dependent on the amount of co-operation given it by the railroads—this co-operation is of prime importance. If such time and co-operation are not available, all that can be accomplished is a thorough discussion on the convention floor of the practices disclosed by the replies to the questionnaire and such questions as may arise at that time.

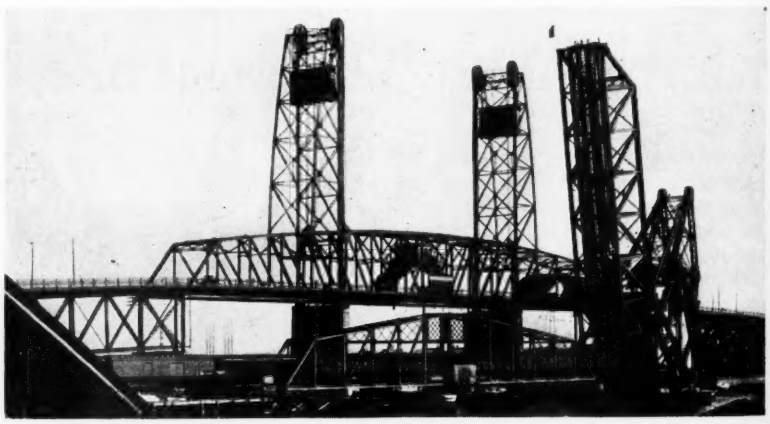
Committee: J. L. Vogel (chairman), bridge engr., D.L. & W., Hoboken, N.J.; H. A. Gerst (vice-chairman), asst. bridge engr., G.N., Seattle, Wash.; A. E. Bechtelheimer, asst. bridge engr., C. & N.W., Chicago; W. R. Ganser, mast. carp., Penna., Camden, N.J.; R. W. Johnson, asst. engr., C.M. St. P. & P., Chicago; F. H. Masters, asst. chief engr., E.J. & E., Joliet, Ill.; C. A. J. Richards, mast. carp., Penna., Chicago; W. H. Norris, bridge engr., Me. Cent., Portland, Me.

Discussion

Supplementing the report as presented, Chairman Vogel read from the correspondence of the committee concerning the specific instructions for operating and inspecting movable spans on several roads, and then called attention to the fact that practically all of the instructions brought to the committee's attention have to do primarily with operation, to the neglect of the maintenance of the spans and their operating mechanisms. He said that this evidenced a serious deficiency which should be remedied by study and recommendations on the part of the association.

After citing the number and type of movable spans on his road, Mr. Vogel pointed out that most of the difficulties with these spans have been occasioned by foundation problems, and inadequate maintenance of wedges and their operating mechanisms. He said that with the proper installation and maintenance of the operating machinery, one should have little trouble with it. To insure the proper maintenance of wedges, he said, these devices on every movable span on his road are examined daily by men assigned to this duty. Supplementing this, he said, a gang makes a monthly check-up on all movable spans, giving particular attention to the alinement and surface of the approach rails.

President Neville said that with the careful inspection and maintenance of the six movable spans on his territory, he has had little trouble with



A Swing Span, a Bascule Span, and a Vertical Lift Span—All in One View

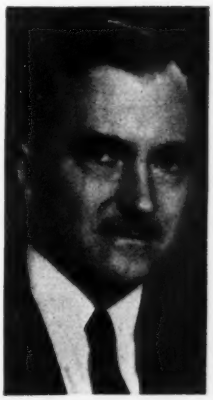
their operation. The operators, in all cases, he pointed out, are carefully qualified men taken from the bridge and building department, and all inspections, he said, are made by the bridge and building department, except one joint inspection made with the mechanical department late in the fall just prior to closing the spans for the winter. This latter inspection, he said, involves a careful check-up of all of the operating equipment to the end that any necessary repairs can be made during the winter months when the bridges are out of operation. Like Mr. Vogel, President Neville called attention to the problem of maintaining the span wedges in proper condition and operating order. He said that to prevent any difficulty in this regard, particularly any difficulties arising from the wear of the wedges, the wedges on all spans on his territory are inspected frequently.

O. W. Stephens (D. & H.) raised a question concerning the cleaning and lubricating of cables, to which Mr. Vogel replied that it was his practice to see that all operating cables were gone over about once a month and wire brushed and greased as necessary. At these times, he said, all cables are also checked for equalization of tension. President Neville said that cables are carefully cleaned once a year on his road and are always thoroughly lubricated each spring at the beginning of the operating season.

To a second question raised by Mr. Stephens, Mr. Vogel explained how he would go about to repair disintegrating concrete counterweights. Briefly, he said that he would first remove all loose or defective material, and then, following patching with a good patching mortar, he would seal and waterproof the repaired blocks with emulsified asphalt.

Recent Developments in the Construction of Timber Trestles

Report of Committee



Walter S. Lacher
Chairman

AS STATED in a report presented at the second convention of this association in 1892, "the use of wood in the construction of trestle bridges is preeminently an American practice." Without doubt, the railroad trestle was an adaptation of the highway structure of the same type, the ties and rails being substituted for the plank floor, and the stringers being altered as to both size and spacing to meet the needs of the new mode of transportation.

While the railroad trestle has been subjected to many changes and further changes are taking place today, the basic elements are still the same as they were in the beginning, namely, bents composed of piles (or posts) and caps, with the addition of sills in the frame structure, and stringers, ties, and what have been variously termed guard rails, guard timbers or fenders.

Of course, the greatest change that occurred through the years was to increase the dimensions or number of the parts to afford adequate strength for the increasing weight of locomotives and cars, and as the most rapid increase in the weight of rolling stock took place in the 20 years beginning about 1890, the period of greatest change in the strength of trestles was coincident with the first two decades following the organization of this association

Two other changes in the design of trestles that took place during the early days of this association were the disappearance of the mortise and tenon joints between posts and caps, and the corbel between the caps and stringers. In 1892 the Committee on Trestles, in commenting on various methods of connecting posts or piles to caps, stated that "the mortise and tenon is the one in most general use, and were it not for the cost arising from the use of high priced carpenter work and the necessity for the great accuracy in framing, it would be the best method of holding together joints." However, this type of joint was by no means universal at that time.

Both of these details went into the discard as knowledge of the behavior of timbers under stress was more widely applied, and it came to be realized that the strength of timbers was greatly decreased by the framing of mortise and tenon joints and that the corbel comprised an inefficient use of timber.

Another influence that brought about changes in trestle design was the introduction of treated wood. Trestles had been built of creosoted wood as early as 1876, but the general application of this material did not come until later, when it led to the introduction of the ballast floor bridge. The general use of creosoted wood in open-deck trestles is a more recent development, and, as is pointed out in another part of this report, is resulting in some well defined changes in trestle design.

The Pile Driver

The most important advances that have occurred in construction methods since this association was organized are the result of improved equipment. In 1892 improvements in the friction clutch of hoisting engines had reached the stage where it was deemed practical to abandon the nippers or cat and attach the hammer line direct to the top of the hammer, although the nipper was still in use as a means of tripping the free-falling hammer.

While the steam hammer was invented in 1845, its use developed slowly and even as late as 1916 a considerable portion of the railroads were still using drop hammers extensively. However, judging from a report presented before the convention of the association that year, the pile driver had reached a high stage of development. The various types of drivers in use at that time are in vogue today, and except for special large drivers that have been built to handle heavy reinforced concrete piles, recent improvements in pile drivers have been confined to the refinement of details that make for

greater reliability, ease of operation and accuracy of driving.

Self-propelled pile drivers have been in use for more than 40 years, but the early propulsion drivers were so slow that they were of no practical use in making the run to sidings to clear for trains and did not, therefore, obviate the services of a work train engine on main-track work. However, during the last 20 years drivers with traction drives capable of speeds as high as 20 miles per hour have been available.

Opinion is divided with respect to the relative merits of the full-revolving and single-end drivers, some roads preferring the first type, while others favor the second. The important requirement is that they be provided with boilers and engines of adequate capacity and that the machinery required for the various functions insures easy and reliable operation, which is as much a matter of adequate maintenance as of good construction. Some bridge maintenance officers recommend that the driver be equipped with a steam-turbine-operated generator to supply current for electric lights, while others feel that carbide lights should also be carried as a part of the regular equipment. Still others recommend an air compressor for the operation of pneumatic tools.

Power Tools

Power tools have come into use to an appreciable extent in trestle construction, the principal items being the chain-link saw and the wood augur, driven by either electric motors or compressed air. While it is true that the practice of preframing obviates the need for much of the boring and cutting otherwise required in trestle construction, this is not yet a factor of such magnitude as to have an appreciable effect in reducing the need for power tools. In any event, all piles must be cut off and bored. Furthermore, power tools are of particular value in the emergency construction of trestles where preframing is ordinarily out of the question. There is, however, at least one case on record of a large structure that was rebuilt of preframed material after a burnout.

One member of the committee directs attention to a type of power tool that should prove of value on all types of work, namely, the reversible power wrench or lag-screw driver. One railroad has obtained excellent results with a wheel-mounted, gasoline-driven, flexible-shaft power unit that can be employed to drive a circle saw or drill. This obviously has its primary application in work on decks. Experience with these power tools has not been sufficiently extended to disclose any distinct preference for either electric or pneumatic power.

Another member of the committee lays special emphasis on jacks. In his opinion, every outfit should be provided with both 15-ton single-acting, automatic lowering jacks, and 25-ton journal jacks.

Hoisting Equipment

In general, trestle timbers are erected with the aid of dollies and portable hand derricks, although a number of roads are making increased use of small power cranes. Rail cranes, for example, are used when available, but there is still a difference of opinion as to the extent to which such machines can be profitably employed. Obviously, they cannot be justified on a small structure of only two or three panels, unless a number of them are being replaced in the same territory, but an entirely different situation is presented when a long trestle is being renewed.

One western railway reports appreciable economies from the use of power cranes, but another road in the same territory has found that on some of its lines traffic interference results in an excessive loss of working time. However, under special conditions, the power crane has proved exceedingly valuable. For example, in a case where trestles were driven across a series of washouts, the work was expedited by having a power crane serve as a tender for the pile driver, bringing up the piles and timbers and passing them forward so that they could be reached by the pile line without the need of backing up the driver.

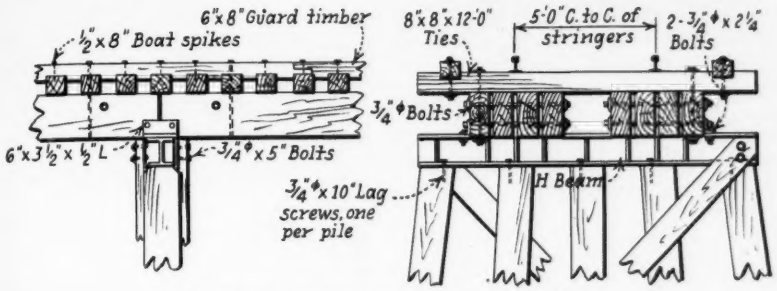
Influence of Preframing

During the last five years, changes in the design of trestles and in construction practices are being brought about by the movement toward the framing and boring of the timbers before treatment. Experience with structures built of treated wood has disclosed that the full available service life was not being realized in many cases because field framing and boring had entailed the cutting of the timbers to such an extent as to leave the untreated or imperfectly treated wood on the interior of the sticks inadequately protected from decay. To counteract this tendency, field forces have been admonished to avoid excessive cutting, but such measures have proved of little avail because the bridge carpenters have no choice but to do whatever framing is necessary to meet the conditions encountered.

The alternative, therefore, is to frame the wood before it is treated, and, as outlined in a paper presented before the association at its convention in 1926, the first efforts at preframing were carried out on the Baltimore & Ohio in 1925. Applied initially to the ties and guard timbers for steel bridges, it was soon adapted also to pile and frame trestles. Other roads took up the idea, and it is now being widely, although by no means universally, practiced, not only as applied to bridges but also to docks, roof trusses, wood box culverts and a variety of other structures.

The preframing of pile trestles presents a special problem because of the tolerances in position, not only of individual piles but of the bent as a whole, that must be taken into account in fitting the other members of the structure to it. As will be shown later, some roads have successfully reduced these tolerances to a point where they are virtually negligible, but the variations in the positions of piles and bents ordinarily deemed allowable in the past introduce serious complications when stringers must be preframed to fit them.

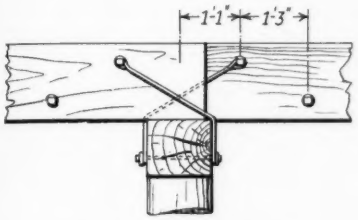
Thus, while the preframing of the timbers for a steel bridge deck or frame trestle involved nothing more than the setting up of a procedure for the accurate and adequate dimensioning of the detail drawings, rigid adherence to these drawings in framing and the marking of each piece in accordance with an erection diagram, it soon became evident that something more was needed in the case of the pile trestle. The result is apparent in the revisions of standard plans for open-deck pile trestles that have been carried out by a number of roads in the last four or five years (following the greater use of treated wood in such structures). In the main, these have had one primary objective, the simplification of shop and field practice in the erection of pile trestles constructed of preframed material. But to an extent, these revisions have been motivated by a desire to develop improvements in the method of fastening caps to piles and the chords to caps. In addition, efforts have been made to effect an improvement in the most troublesome element of the trestle—the cap. Perhaps no detail has received more attention than the drift bolt, a fact that is of particular interest because the shortcomings of this device were discussed at the con-



Steel Cap Developed on the Northern Pacific

vention of this association 45 years ago. It is of interest also that some of the substitute fastenings recently adopted are not unlike some that were suggested at that time.

Some of these recent developments in the design of pile trestles were reviewed in the report on preframing presented at the last convention, but



Design of Stringer Stay Rod

it seems well to review these briefly and describe others, also, in pointing out the problems presented and the manner of solving them.

From the standpoint of its connection to the piles, preboring for drift bolts introduces no problem, since it does not involve the matching of corresponding holes in the piles. Only a few roads, therefore, have adopted any substitutes for the drift bolt as the fastening between the cap and the piles, these being principally in the form of a pair of steel bars or angle irons bolted to both the cap and the piles by horizontal bolts.

New Cap Designs

It is of interest to observe, however, that three roads have adopted special measures in an effort to overcome unsatisfactory service from caps. The Atchison, Topeka & Santa Fe has adopted an increase in size—to 14 in. by 16 in. on heavy traffic lines, without introducing any innovations as to details. The Southern Pacific Lines in Texas and Louisiana have developed a design that might be described as an armored cap. The 12-in. by 14-in. timber is covered on top with a ⅜-in. steel plate, the most important function of which is to distribute the bearing pressure from the stringers, while its secondary function is to provide the means of attaching angles to which the stringers are secured to the cap. Another outstanding feature is the use of 11 horizontal bolts and 3 vertical bolts through the cap that resist checking or splitting, although most of the bolts serve some other purpose as well.

All-Steel Caps

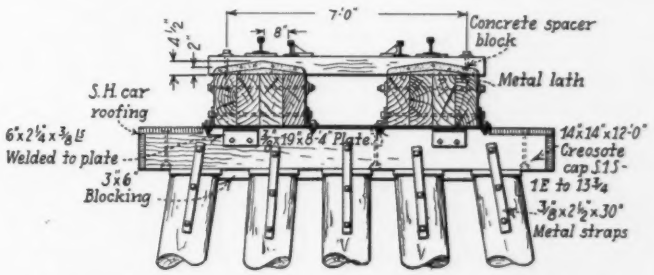
This road has recently gone one step further and used all-steel caps for trestles constructed otherwise entirely of wood. This development, undertaken in part to find use for some second-hand material, embodies the use of two wide-flange I-beams with cover plates on the top and bottom. The method of connection to the piles is unique—a dowel pin welded to the bottom of the cap that fits into a piece of pipe that is forced into a hole bored in the top of the pile. This is supplemented by clip angles having one leg against the bottom of the cap and another against the face of the pile. One bolt goes through the pile and another through the flange in the steel cap.

The Northern Pacific has developed a steel cap for use on open-deck untreated trestles, consisting of a 12-in. H-beam with plates welded between the flanges to serve as bearing stiffeners, over the piles and under the chords. In this design the connection to the piles is made by means of ¾-in. by 10-in. lag screws, enough holes being provided in the bottom flanges of the cap to give a choice that allows for normal variation in the location of the piles. In both the Southern Pacific and Northern Pacific designs bearing faces are provided at opposite sides of the two ends to receive the brace plank, a piece of channel being used in one case and an angle in the other,

Chord-to-Cap Connections

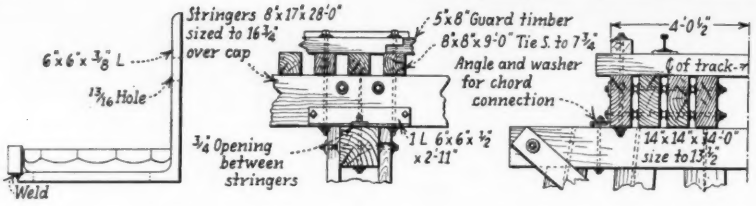
A greater variety of fastenings has been developed to take the place of drift bolts in attaching the stringer chords to the caps. One of the first of these to be used is the stay rod, a 1-in. rod with an eye at each end. One eye is bolted against the face of the stringer by means of a chord bolt and the other to the side of the cap by means of a horizontal bolt through the cap. These rods are furnished straight with only one eye, the bending of the rod over the edge of the cap and the forming of the second eye being done in the field, thus permitting considerable leeway in the position of the chord-bolt holes relative to the cap. The rods are used in pairs, one pair on the outside and another on the inside of each chord. This design is in use on the Burlington and the Chesapeake & Ohio.

One division of the Missouri Pacific has used four-inch channels.

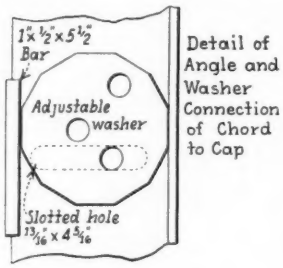


Cross-Section of Trestle Developed on Southern Pacific, Texas and Louisiana Lines

placed vertically between the stringers, thus serving also as spacers, these channels being punched through the flanges for chord bolts and through the webs for horizontal bolts that pass through the cap. The Santa Fe fastening consists of a steel bar bent at each end so that it can be bolted to both the stringer and the cap like a knee brace, an arrangement that requires vertical bolts through the stringer.



Detail of Cord Connection to Cap Used on the Union Pacific



Detail of Angle and Washer Connection of Chord to Cap

In the Southern Pacific design the connections to both the stringers and the cap are made by means of angles, with their axes horizontal, as shown in the sketch, both sets of angles being attached to the steel plate that covers the top of the cap. This cap is prebored and is shipped to the job with all hardware attached to it.

The Union Pacific also uses a steel angle for making the connection between the chords and the caps. This angle is placed with its axis horizontal, its outstanding leg being bolted to the cap by one bolt and its vertical leg being attached to the stringer by two chord bolts. The distinctive feature of this design is that it embodies provision for lining the deck relative to the bents, as shown in the drawing.

Stringer Chords

Practice in the arrangement of the stringers is subject to two major variations, namely, that providing for parallel packing with butt joints on the caps and that in which the stringers are lapped, thus permitting greater leeway in the lengths of the stringers without causing difficulty in getting adequate bearing on the caps in spite of some variation in the position of the bents. If the bents are located with a high degree of accuracy, the parallel arrangement of the stringers can be readily applied to preframing, and permits of preboring the deck anchor bolt holes in the stringers, something that is not readily possible if all the stringers are on a skew. However, the skewed arrangement of the lapped chord plan does not prevent preboring of the chord bolt holes, if the chords are laid out in assembled form at the preframing plant, as is done by the Chesapeake & Ohio. Some roads, however, prebore only the outside stringers for chord bolt holes, these stringers then being used as templates for the field boring of the other stringers after the chords have been erected.

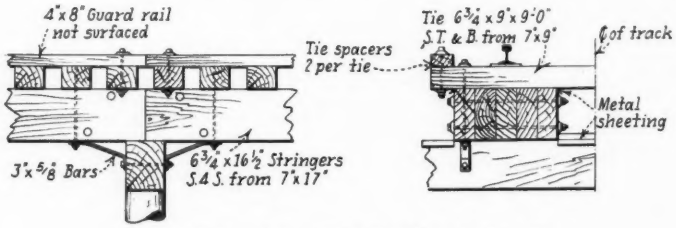
Preboring Practice

While there is general agreement as to the feasibility of preframing most of the timbers that go into a trestle, there are wide differences of opinion as to the extent to which the bolt holes can be prebored. It is contended by officers of the Missouri Pacific and the Southern Pacific, Texas and Louisiana Lines, that it is readily practical to prebore all holes except those in the piles. Others contend that this is not possible unless the piles are driven and capped first, permitting measurements to be made of the location of the completed bents before the deck material is framed. Still others take the position that inasmuch as the answer is the degree of accuracy obtained in driving the bents, the question resolves itself into one of the character of material into which the piles are driven—that it is one thing to drive piles in alluvial bottom lands where the subsoil is of uniform consistency and quite another to drive them in ground presenting widely varying resistances to driving.

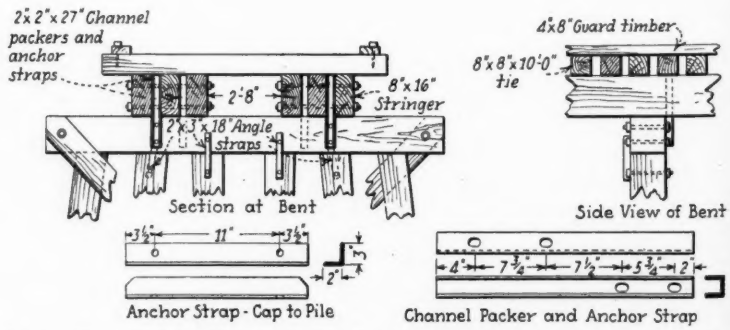
Accuracy in Pile Driving

Those who are convinced, as a result of experience, that a high degree of accuracy is possible in the driving of trestle bents point to specific practices in driving that are effective to this end. For example, L. G. Byrd, supervisor of bridges and buildings on the Missouri Pacific, offers the following:

"The panel spacing of pile bents should be checked closely by the use of an accurate steel tape, taking measurements on both sides of the track and setting a nail in the outside of each guard timber. After the locations have been established, stakes should be set for the location of each pile, with the aid of a plumb bob, working outward from the center line of each bent. Holes two feet or more in depth should then be dug or bored for each pile. The driver must be accurately spotted and the leads correctly set, being careful to see that the pile is in exactly the position it is to occupy in the bent before the hammer is allowed to rest on it. If the pile has a crook, it should be placed so that the plane of the bend is in the plane of the bent.


4"x8" Guard rail not surfaced
Tie spacers 2 per tie
3"x⅝" Bars
6¾"x16½" Stringers S.4 S. from 7"x17"
Tie 6¾"x9"x9'-0" S.T. & B from 7"x9"
℄ of track
Metal sheeting

Stringer Connection to Caps Used by the Santa Fe



Stringer-to-Cap and Cap-to-Pile Fastenings Used on One Division of the Missouri Pacific

If possible, drive the pile so that if it has any tendency to spring when released from the leads, it will spring toward the center line rather than away from it."

Although only a few roads prebore the stringers completely, it is rather widely accepted as a practice that offers no particular complications, so far as bent connections and chord bolts are concerned. However, the case of the ties and guard timbers is not so conclusive, and while some contend that they have no difficulty in preboring all holes on tangent track structures, the matter of line introduces a pertinent question. If the ties are prebored for track spikes as well as for deck anchor bolts, it is necessary that the bridge be so accurately lined from the caps up, that the track will be in line when the rails are spiked in the prebored holes. This is not true in the Union Pacific design, since this makes provision for the adjustment of the alinement of the stringers relative to the caps, as previously described. In most cases, therefore, it is considered necessary to confine preboring of trestle ties to the holes for the track spikes. This, of course, does not prevent the complete preboring of guard timbers.

More Efficient Fastenings

While the discussion of fastenings thus far has had to do entirely with those designed to facilitate preframing, there is a trend toward the use of various new fastenings for other reasons. Possibly the earliest application of these newer types of hardware was the use of a special form of connector between the tie and the guard timber as a substitute for the dapping of the guard rail over the ties. More recently a number of connecting devices have been introduced after extended tests and experience that demonstrate their superiority over the usual bolted connection in transferring the stress from one timber to another. As pointed out recently by the Committee on Wood Bridges and Trestles of the American Railway Engineering Association, the usual single-bolt connection of a brace plank to a pile falls far short of developing the available strength of the 3-in. by 10-in. or 4-in. by 8-in. braces commonly used, and one road has recently applied a special connector designed to fit the curved pile surface, as a means of obtaining a more efficient fastening. Another road has recently adopted a form of bolt in which the washer is an integral part of the head. These, however, are but the beginning of a development that should greatly increase the efficiency of joints in wood structures.

Protecting Treated Wood

It is common knowledge that creosoted piles fail due to decay under the caps, for which reason it is usual practice to apply some sort of preservative treatment to the cut-off before the caps are placed—usually the application of hot creosote. One member of the committee urges several successive applications, with an interval of time between to allow the oil to be absorbed. Another submits specific instructions as follows:

"The hot creosote should be poured on as long as it will penetrate, after which the surface should be covered with cold coaltar pitch ⅛ in. thick. After laying on a layer of roofing paper that has been boiled in creosote oil, apply another coat of coaltar pitch and cover with a second layer of roofing paper to protect the pitch when the cap is set in place."

Still another member recommends metal covers for the tops of piles, a not unusual expedient.

While decay around bolt holes in creosoted piles that are otherwise sound is by no means universal (where the holes are filled with bolts), it is a sufficiently general experience to demonstrate the need for the best possible treatment of field-bored holes. For this reason increasing use is being made of one or more kinds of "guns" for the application of creosote to the holes under pressure. Following is the practice specified on the Santa Fe:

"Pressure treat or swab the entire hole with hot preservative, followed by sealing compound applied hot, and immediately drive the bolt in place. All bolts should be cleaned of all rust and scale, and dipped in hot sealing compound before being driven. All unused holes, either prebored or bored in the field, shall be fitted at each end with 13/16-in. by 4-in. treated plugs. These plugs shall be dipped in hot sealing compound before being driven."

While the above covers the principal measures taken to overcome the damage done to treated wood by reason of field cutting and boring, it is just as important to guard against injury to timbers in unloading and handling. Concerning this, the instructions issued by the Santa Fe are as follows:

"Damaging of the surface of treated timber or piles by the unnecessary use of timber hooks, peevies, etc., should be avoided. When possible, treated timber or piles should be handled by rope slings. The dropping of treated timber or piles from any height should be discouraged at all times.

"When it becomes necessary to work from scaffolding in constructing the bridge, such scaffolding should be hung by ropes and not nailed to the treated timber or piles."

For scaffolds, one member of the committee recommends the use of bent rod hangers hooked over the ties, or eye-rods suspended from straight rods passed through the eyes and resting on the ties. However, one member of the committee feels that the most common need for a scaffold, namely, for cutting off the piles, can be fulfilled by the binders that are applied on each side of the bent and drawn up by bolts, for lining the piles.

Summary

1. Practice in the construction of trestles has not been influenced to any extent in recent years by any marked changes or improvements in pile drivers. There is a definite trend toward the greater use of power tools and small rail-mounted power cranes, but they are as yet by no means in general use.

2. Some railroads have modified their designs of trestles to facilitate preframing and to effect improvements in certain details, especially the connections.

3. Preframing is entirely practical, but wide differences of opinion prevail concerning the extent to which preboring may be done. Preframing and preboring are facilitated by greater accuracy in pile driving and by completing the bents before the deck material is ordered.

4. Realization of the greatest service from structures built of treated wood demands careful adherence to well-defined practices that are designed to guard against injury to the timbers during erection and for the field treatment of surfaces exposed by cutting or boring in the field.

Committee—W. S. Lacher (chairman), managing editor, *Railway Engineering and Maintenance*, Chicago; E. E. R. Tratman (vice-chairman), const. engr., Wheaton, Ill.; Maxfield Bear, chief conc. insp., C. & N.W., Chicago; C. N. Billings, supvr. b. & b., S.P., Ennis, Tex.; M. A. Bost, asst. engr., C.M.St.P. & P., Mason City, Iowa; L. G. Byrd, supvr. b. & b., M.P., Poplar Bluff, Mo.; L. D. Garis, gen. bridge insp., C. & N.W., Chicago; W. G. Kemmerer, asst. engr., Penna., Chicago; W. F. Koehn, b. & b. mast., C.P.R., Montreal, Que.; C. L. Metzmaker, supvr. b. & b., C. & I.M., Springfield, Ill.; George W. Rear, bridge engr., S.P., San Francisco, Cal.; L. J. Tetreault, asst. foreman, b. & b., N.Y. N.H. & H., Worcester, Mass.

Discussion

The early part of the discussion of this report centered around the use of power-driven tools for bridge work, and all of those who commented on this subject found these tools of large advantage. L. D. Hadwen (C. M. St. P. & P, retired) told of his experience with electrically-driven cross-cut saws and said that while these saws were effective, he had found that they presented the hazard of shock to the men when operated in wet places. For this reason he had turned largely to the use of air-driven saws and had found them highly successful. C. S. Heritage (K.C.S.) said that his road had used air-driven augers extensively. J. H. McClure (C.N.R.) reported that he had used air-driven saws effectively, both in pile cut-off work in the field and for preframing timbers, and T. P. Soule (N.Y.C.) said that on his territory not only power saws, but also air drills and air wrenches were used to advantage.

Turning to the relative advantages of treated and untreated timber, W. Walkden (C.N.R.) said that on the Western region of his road, where there are approximately 60 miles of timber bridges, it is the practice to use treated caps and sills, with untreated timber in the remainder of the structure, it having been observed that it was invariably the caps and stringers which required premature renewal. In some cases treated stringers were also used. He pointed out that this practice increased the cost of new structures from 10 to 25 per cent over that for entirely untreated structures, but that it had been found that the increased life obtained more than justified the increased cost involved. Mr. McClure said that his experience had been the same as Mr. Walkden's, that the caps and sills invariably go first, and that for this reason he was inclined toward the treatment of these members in otherwise untreated structures.

L. G. Byrd (M.P.) stressed the importance of preframing. He said that his road had been following this practice for the last eight years, and that in the construction of approximately 13,000 ft. of open-deck and ballasted-deck trestles within this period, he was sure that not more than two dozen holes had been bored in the field.

H. I. Benjamin (S.P.) told of the extensive mileage of timber trestles on his road and said that in all new construction treated timber is used exclusively, regardless of prevailing climatic conditions on different parts of the line. He said that preframing is the rule, and that it is the practice to pressure-treat any holes which must be bored in the field. Pointing out that 35 to 40 years' life is expected from these structures without extensive maintenance, he strongly opposed the use of untreated timber in new construction. As regards bridge and trestle ties, Mr. Benjamin said that his road used a salt treatment rather than a creosote treatment because of the smaller fire hazard involved. In some cases, he said the tops of ties are coated with a cement paint, filling all cracks and thus further minimizing the hazard of fire.

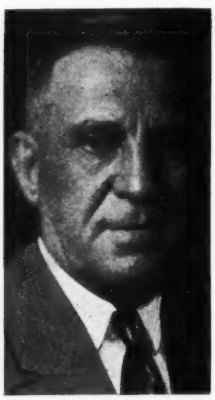
C. E. Smith (N. Y., N. H. & H.) said that as the result of a recent serious fire in a main line trestle on his road, those in charge of bridge construction and maintenance were becoming highly skeptical of treated timber for trestle ties and stringers. He said, however, that there was no concern about using treated piling, which was the practice in the few timber structures still remaining in the main lines of the road.

Why Bridge and Building Men Are Injured

By S. H. OSBORNE
Assistant to Vice President, Union Pacific System

I HAVE been an employee and an officer of the maintenance of way department during 32 of my 37 years railroad experience, in capacities ranging from foreman to engineer maintenance of way. I have spent most of this time as a division engineer on a railroad where this position carries direct supervision over all men employed in that department. In this work I have had intimate contact with the men of the bridge and building department in a territory extending from the Missouri river to the Pacific coast.

During my entire maintenance of way career the responsibility of supervising forces for the conduct of work coming under their direction has been forcibly impressed upon me by our management and in turn upon all supervisors under my direction. I have always worked under an aggressive management that was not satisfied with the passing off of unusual or unexpected accidents and personal injuries to employees as unfortunate happenings but insisted on thorough investigation and development of facts, followed by corrective measures to prevent their repetition whenever it was at all possible to take such action.



S. H. Osborne

Gradually it grew into my knowledge that accidents do not just happen, but are caused, and also that the cause was divided into three prime reasons which may be classified in a general way as:

(a) Supervisory responsibility.
(b) Foremen's lack of character or of knowledge.
(c) Individual careless and thoughtless acts on the part of employees.

Supervisory Responsibility

Supervisors must know their duties and responsibilities, have the interest to observe practices of their foremen, and the intestinal fortitude to correct violations of rules and instructions relating to their work and the handling of their men. They must be familiar with good practices and with maintenance and safety rules and be able to get over to their men the necessity for strict conformance thereto and obeyance thereof. This demands that they be firm in their requirements and tactful in their contact with foremen and men.

The supervisor who is indifferent or evasive in accident prevention cannot hope to have a good record in

safety work. As an example, a bridge and building supervisor inspected the method being used in supporting an engine house roof during the renewal of permanent posts. The foreman and men were engaged on the work at the time of the inspection and at that time a permanent post had been removed and the roof was supported on temporary posts on blocking. The following morning a carpenter was framing the new post while the foreman and other men were outside the building procuring material, when the temporary support gave away and a portion of the roof fell on the carpenter, causing injuries from which he died. The investigation developed the fact that the supervisor knew the method being followed was not in conformance with the specified practice but did not insist upon such conformance because the foreman was an experienced man in that work, and had renewed several posts in the same general manner without mishap. This supervisor knew the prescribed practice for this work, but it required slightly more labor in its use and he apparently was reluctant to correct a foreman who he probably thought knew more about the work than he did.

Supervisors, particularly those with long service as such, sometimes come to depend too much upon their foremen and are remiss in their instructions and in the checking of work being done under their direction. I call to mind a period during which we were having an unusual number of track car accidents. Investigations nearly always developed the fact that the accident was caused by tools falling off car, brakes not holding, striking some object on track, striking or being struck by automobiles on crossing, etc., and responsibility was being placed with the foreman.

The management was asking so many embarrassing questions that were difficult to answer, that instructions were issued all over the railroad which in substance made the stopping of such accidents, with their attendant property damage and personal injury, a supervisor's responsibility. Two roadmasters and a building and bridge supervisor were discharged shortly after for track car derailments and it was unnecessary to assess any more discipline for accidents of this character for a long period of time. The accidents stopped, because the foremen and the men were being fully instructed, checked on their observance of rules and corrected in unsafe practices.

Supervisors have a direct influence on accidents and personal injuries and can do much in their prevention by knowing that their men understand and observe the rules, for nearly all rules are safety rules, and that they do not indulge in unsafe practices as a means of making short cuts in and reducing their own work.

Some may say that strict observance of rules and safe practices reduces production. I can tell you that it increases production and reduces costs by stopping loss of time in a gang of men when a serious injury occurs; it also reduces claim payouts. Figures have been assembled on many jobs where fatalities and serious injuries have occurred and they have always substantiated this statement. In addition, the morale of employees is better when they see that the rules of safe practice are being carried out in full detail and that men are not allowed to do work in a careless manner or to work upon unsafe supports of any character. Better morale means more and better production and decreases injuries due to individual slip-shod work and careless movements.

The Supervisor's Part

Also, some of you may believe that supervisors, on account of the size of their territory, cannot go into all of the details which are the cause of employee casualties but let me get this thought over to you. A supervisor who, when on the line, watches all of the details of the work being done by his forces every time he contacts them, and corrects his foremen in unsafe practices; insists that hazards of falls occasioned by material and tools on bridge decks and ground are not allowed to exist; that rules for proper flag protection are being carried out and who shows by his attitude that he is taking an active interest in all measures relating to safe practices in the protection of men and work, soon gets his foremen in line with this attitude and they will carry on in the same manner during his absence.

A supervisor who has his foremen meet him at the station where the train stops, that he may obtain information as to the progress of the work and the materials required; who lines these foremen up for other work and details of such character, and who does not spend some time with each gang checking how the work is being carried on, is creating a situation in which he is placing dependency entirely in his foremen and is not functioning as a supervisor in the detail required for the proper and safe conduct of work and of accident prevention. A supervisor, to be successful, must know the manner in which each of his foremen carries on his work. He can get this information only by personal contact and observation. The more such contact he has, the better is his supervision and the better is his accident record.

Lack of Knowledge on Part of Foremen

Foremen are necessarily made from experienced employees. They may have all the qualifications of a good workman and still be lacking in the knowledge necessary to be leaders of men. They may keep aloof from their men or handle their work in such a manner as to lose the respect of their gang. Without force of character sufficient to require their men to live up to safety rules and energy enough to see, insofar as possible, that this is being done, they are failures in accident prevention.

Foremen may be assigned to work of a character and size beyond their capacity to carry on economically and safely from an accident prevention standpoint. I have in mind a foreman who had long been in charge of gangs of from 8 to 12 men and who was assigned to work which required a gang of 30 to 40 men. In a short time several falling injuries of a serious character occurred. An investigation was held in each case and responsibility was placed with the employee injured, as no contributing causes could be determined. The supervisor exchanged this foreman for another man and the new foreman carried the work on to completion expeditiously and without further personal injuries. The failure of the first foreman was due to his endeavor to get production and paying too little attention to the manner in which the work was handled,—a bad experience for his men and an expensive one for his company.

Lack of Character

Many foremen do not have the ability or force of character to correct and to require employees to pursue safe practices and follow rules and instructions. Recently a case of this kind came to my attention where, in unloading a car of bridge timbers on a storage pile with the use of a locomotive crane, a timber that was hooked off center swung downward, struck a pile already unloaded and came loose from the hooks. A carpenter engaged in guiding suspended loads to the various piles, in getting away from the falling timber, fell and struck another timber, causing a head injury from which he died several days later. Investigation de-

veloped that the foreman had told the man to keep from under the swinging loads and that he had obeyed in a half-hearted fashion. It was the duty of the foreman, who was present and witnessed the accident, definitely to instruct the men where to place themselves in connection with this work, and to see that his instructions were completely fulfilled. It is carelessness of this kind and an unexpected happening which causes many so-called accidental casualties.

Another cause of injury is individual careless acts, and a foreman not observing, or not correcting, his men in such acts. Men as a rule are not thinking animals; they act in accordance with past practices, whether such practices are good or bad, and it is the bad practices in the conduct of their work which a foreman must correct if he is to keep personal injuries among his men down to the minimum. Foremen can be firm and decisive in their requirements and this will hold the respect of their men. Character is an attribute of good foremanship.

In the use of tools, such as jacks, bars, adzes, draw knives, saws, etc., inexperienced men are guided by and learn from older men. If they learn wrong ways and methods they pursue them unless corrected and shown the right way. Failure to correct such men leads to many injuries. Some men can be instructed and profit by such instruction; others have to be shown, not only the right way but how injuries occur when the tool or equipment is not properly handled.

A good foreman is one who may or may not be as good a mechanic as some of the men of his gang, but who knows how good work must be done, who knows the prescribed practices and follows the rules and specifications for all protective measures in connection with his work. He is one who can take precautionary and protective measures in accident prevention and one who retains the respect and good will of his men. Such a man is invaluable and we have records of cases where they have carried on their work *as long as 14 years without a lost-time injury.*

Careless and Thoughtless Acts

Men do not pursue unsafe practices as a rule. If they did they would not be retained in railroad service. The injuries they sustain are caused, for the most part, by not sizing up a situation to determine the right or wrong approach, but going ahead with what they are doing or are about to do in the way that first occurs to them, or that presents the least effort on their part. An illustration of doing work in a way that presents the least effort is the case previously cited where a carpenter was killed in getting away from a falling timber. All this man had to do to carry on his work safely was to take a few steps backward and forward in guiding a suspended load into place, but he was not smart enough to sense the possibility of an unlooked-for occurrence.

Another accident occurred where a carpenter who was constructing concrete forms, was sitting on the top edge of the form and reaching across to the opposite side to nail on a strip, when he fell onto the reinforcing steel within the form and received injuries from which he died. By walking some 20 ft. he could have gone to the other side and done this work from the ground. If it had occurred to him, he would undoubtedly have used this method.

Still another illustration; a group of men were engaged in raising a bridge cap into place, when a carpenter, for some unknown reason, got into a position whereby his head was caught between the cap and the bridge stringer above, causing a skull fracture. He could offer no explanation for getting in such a position.

Such accidents can be attributed to thoughtlessness in some cases and to taking a chance to save time in others. In any case it is the duty of a foreman observing a man getting into such a position or performing his work in a manner liable to result in an injury, to explain to the man the probability of personal injury from the method he is pursuing or attempting to pursue. Where a foreman watches and corrects his men, it is my belief that their sense of personal safety may be developed, with beneficial results to them, and to their employers, and by instructing them in right methods, the repetition of injuries due to the same causes is made less probable.

I have said that as a rule man is not a thinking animal. Tests have shown that the average mentality of citizens of the United States is that of a thirteen year old child. This means that many men in your employ have mentalities much below that of the average. Remember this and it may give you a viewpoint which will be helpful to you in your methods of approach and of instructing men. Simply talking Safety may benefit some but many others require illustrative demonstrations of unsafe and safe ways of doing work in order to grasp the safety features of doing work properly.

You are the men on the firing line, —the direct contact between management and labor. You are the Safety Men upon whom the managements must rely and you must function fully if you are to help the cause of employees. Yours are the guiding hands and instructing brains upon which your officers depend in the great humanitarian and economic work of accident prevention.

Discussion

In the discussion which followed this report, James Wilson (C.N.R.) outlined the methods which he employs to stimulate safe practices among his men. He stressed the importance of local safety meetings and the value of frequent discussions of safety with his men in the office or on the job, even though these discussions may be brief. Such repeated discussions, he said, keep foremost in the minds of the men that the boss is safety-minded and that they must constantly give safety first consideration in all details of their work.

Mr. Osborne commended the practices outlined by Mr. Wilson, and then, supplementing the remarks in his address, outlined some of the safety measures employed on the Union Pacific. Among these he mentioned periodic safety meetings, detailed rules on safety and safe practices, accident bulletins, a monthly publication describing and analyzing every reportable accident within the period covered, and the issuance of safety post cards soliciting suggestions from the men with regard to unsafe conditions and safety practices. A. C. Sachs (C.N.R.) said that his road also used safety cards to solicit suggestions from the men, but it developed in the discussion that on most roads where such cards are used, the preponderance of suggestions received have to do with unsafe conditions rather than unsafe practices. In view of this, it was brought out that the men should be further encouraged to think about and to develop safer methods of carrying out details of their work. Mr. Osborne said that all suggestions received from the men on his road, regardless of their importance, are given careful consideration, and that each is acknowledged, advising the contributor what action has or will be taken.

In reply to a question raised by C. D. Turley (I.C.), Mr. Osborne said that his road has detailed standards for carrying out many different operations safely, but that where no standard method applies to an operation at hand, and there is a difference of opinion as to the safest method of carrying it out, the man in charge of the work should be the one to decide how the work should be done, consulting with his immediate superior officer if this is possible.

Elmer T. Howson *(Railway Engineering and Maintenance)* compared the enviable record of the railways in handling passengers with the record of employees killed and injured in the service, and pointed out that the still large number of accidents among employees presented a challenge to every railway man to improve the employee accident record. He then cited the unusually fine safety record on the Union Pacific, and suggested that unquestionably this was the result of the active interest of the management of that road in the safety movement, and so far as the bridge and building department is concerned, was accounted for by the fact that the safety program of the road is conducted by men intimately familiar with bridge and building work.

Meeting Today's Demands for Water Service

Report of Committee

IT IS estimated that the locomotives on North American railroads evaporate 335 billion gallons of water annually. If we add to this figure the water consumed by shops and engine houses, and that used for drinking and other purposes, we arrive at a total of 600 billion gallons of water, which exceeds all other materials used by the railroads in both volume and weight. This water, which is supplied by some 18,000 water stations, would be enough to meet the needs of a city of nearly 17 million people. To provide this service the industry has in excess of 400 million dollars invested in its water stations and spends every year nearly 50 million dollars for maintenance and operation. The problems of water supply are as old as the railroads themselves, so we may ask in what ways demands todays' for water service differ from those of former years.

Speeds have greatly increased in both freight and passenger service in recent years. Schedules for streamliners are computed on the basis of seconds of time and those of many other trains have been shortened to the point where little slack time remains in which to make up delays. When a locomotive is prevented from taking water at a regular station it will nearly always have to make at least one additional stop for water elsewhere at the sacrifice of time.

In the case of a passenger train the regular stop for water may be at a point where the engine is serviced. In such a case the entire time required to take water elsewhere is lost. The facilities for taking water at the more important stations are also usually better than at the others.

H. B. Christianson
Chairman

Freight trains may have their regular stops for water at stations where switching must be done or a helper engine is coupled on. If a freight train on the Milwaukee, for instance, is unable to get water at Sparta, Wis., and must take it at Tomah, 30 min. will be lost in the running time of that train. Retarding the progress of one train may also adversely affect the running time of following or meeting trains, and if a train that is delayed must get into clear on a siding considerable additional delay is incurred. Because of the serious consequences of water service failures in the form of delays such as have been cited above it is essential that they be eliminated. Water service, to be efficient and satisfactory, must keep pace with the requirements of modern speeds.

Other changes in conditions are also with us—heavier locomotives, larger tenders, longer runs. Water service organizations must be alert to the possibilities of economy, recommend aggressively the retirement of water stations that have become of doubtful necessity, and make much better use of the money thus saved by improving the more important water stations.

Larger Tenders Permit of Wider Spacing of Water Stations

Larger Tenders

Twenty years ago there were few tenders with capacities of 12,000 gal. of water. Now many of the new locomotives that are being purchased have tender capacities of 20,000 to 23,000 gal. This trend, together with the greater efficiency of locomotives, is permitting the lengthening of the distances between water stops in many cases. At one point on the Canadian National, a 100,000-gal. water tank, fed by gravity supply, began running short of water, although there was no reduction in supply. Investigation developed that, although fewer locomotives were stopping for water, 90 per cent of them had tender capacities, 2 and some 2½ times that of the engines in use when the plant was put in service. The larger tender capacities permitted freight trains to run by two outlying water stations and take nearly full tanks of water at the station in question. The solution was found in providing more water at that place.

Improved business conditions and the resulting increase in traffic have introduced new problems; for example, the running of multiple-section passenger trains has increased the demand on important water stations that had previously been considered adequate. In keeping step with modern demands it is necessary to improve, remodel and, in some cases, enlarge our facilities. Close co-operation with the operating and mechanical departments is of advantage in making studies to determine where the outlays may be made most profitably and to convince the managements that the expenditures are warranted.

To meet the demands of fast train

schedules, some of the eastern roads have long made use of trackpans for the taking of water on the run. There are over 100 such installations in service in territories of heavy traffic density, but the high costs of operation and maintenance of such facilities seem to indicate that larger engine

Track Pans Are Confined to Eastern Roads

tenders offer a more satisfactory solution as the increased carrying capacity makes fewer water stops necessary.

Larger Locomotives

When larger locomotives are purchased, changes in water service facilities are usually necessary. It may be necessary to institute a general raising of water columns and a relocation of certain water columns, where their spacing with reference to main track cinder pits require it to permit servicing the engines with one stop. The increasing length of runs has made it important that the water over the longer territory be as uniform in quality as possible, and this may call for further refinements in water treatment.

As in the case of the water stations mentioned above, which have become inadequate under the demands of closely-spaced, multiple-section passenger trains, it has been necessary to increase storage capacity because of the more exacting demands of faster service. In other cases tanks have been found to be too low to furnish adequate head. Each case of this kind presents a distinct problem of its own.

Where service lines are of inadequate size to furnish the desired amount of water in a given time, many have been replaced with pipes of larger diameter. Where two columns are on one line from the storage tank, the size of the main has been increased in some cases to 16 in. diameter, with 12 in. lines to the separate columns. Many railroads have found it possible to increase the discharge of pipe lines by undertaking extensive programs for the cleaning of pipes to remove incrustations. Additional precautions to guard against delay to trains have been afforded at many points by making auxiliary connections with city water systems.

It is interesting to note that about one-third of all water used by railroads is purchased from towns and cities along the route. Constant study and frequent negotiations are required in connection with such service. Improvements have been made to guard against flood and fire losses. Stand-by units have been installed at numerous electrically-operated water stations to guarantee uninterrupted supply.

Better Equipment

While no figures are available which show the number and the various kinds of power units and pumps used by the railroads, it is evident that the present trend is toward the use of semi-Diesel oil engines or electric motors with horizontal centrifugal pumps, and vertical centrifugal or deep-well turbine pumps. Turbines are now available that will pump against heads of 400 ft. or even greater, and as a result railroads have been able to develop deeper well supplies and to pump water to elevated tanks located on higher ground in the most advantageous position for servicing trains. Most of the rebuilt or new stations have been equipped with automatically-controlled units, with a resulting decrease in operation costs.

Studies, involving close co-operation with the operating and mechanical departments are being made to determine the best locations for new installations. At many places tanks have been erected near stations where passenger engines take water, in order to increase the discharge through the water columns. Other important water stations have been moved to locations where long freight trains may stop without blocking street crossings.

In the development of the new supplies, the railroads are becoming more exacting in regard to the quality of the water. The geology of the source and the possibilities for pollution are investigated, and thorough chemical analyses are made to determine the content of dissolved solids and the effect of the new water on boilers. This branch of the water service organization can safeguard the railroad against the spending of money in the development of supplies that are unsuited for use in locomotives. There is no excuse for overlooking the quality of the water, even if subsequent treatment may make such supplies usable.

Decided advances have been made during recent years in the treatment of water to prevent scaling, pitting and foaming in boilers. We are now treating waters which were formerly considered satisfactory for use in their raw state. Thirty years ago there were very few water treatment installations, while in 1933 more than 2,000 stations were treating 40 per cent of the water used by locomotives. This number of installations included some 1,200 wayside treating plants of the lime and soda type, each of which treated an average of 75 million gallons a year; 600 soda ash or sodium aluminate stations handling an average of 25 million gallons a year each; 350 plants for the introduction of commercially-prepared boiler compounds, each of which treated an average of 50 million gallons a year; and

A Water, Coal and Sand Plant

100 zeolite plants, each of which treated an average of 120 million gallons a year. Thus, 135 billion gallons a year were treated before reaching the locomotives, and it has been estimated that 100 billion gallons more were treated by various preparations after the water was delivered to the tenders.

Progress in Treatment

Incomplete figures for 1936, taken from a survey made by C. P. Richardson, engineer of water service of

the Chicago, Rock Island & Pacific, for the American Railway Engineering Association, show that 22 railroads, that pump about one-quarter of all the water used in this country, treat 50 per cent of their water before delivery to locomotives. These railroads alone operate 1,270 water treating plants at the present time, compared with the estimated total of 2,000 plants on all the railroads in 1933. The figures cannot be taken too literally as representative of all of the railroads, because most of the roads in question are located in the West and Middle West, where more water is of a character that demands treatment. However, the figures seem to indicate that there has been a substantial increase in the number of treating plants since 1933.

Savings Large

Chemical treatment of water has increased the efficiency of operation of American railroads and brought about an estimated saving of 12 million dollars annually. The 22 railroads cited remove 65 million pounds of incrusting solids annually and this has resulted in increased conservation of fuel, has doubled the life of locomotive fireboxes and flues, and brought about a reduction of 50 to 75 per cent in the amount of corrosion and pitting. Thus, the number of locomotive miles run between engine failures due to boiler conditions is now more than five times what it was as recently as eight years ago.

Although breakdowns of our water servicing facilities happen occasionally, the water service departments, by an orderly system of inspections and repairs, are helping to prevent these objectionable occurrences. Some railroads are carrying out a policy of monthly and, in some cases, quarterly inspections with success.

Failure to give service has an immediate effect on train schedules and, of course, the more important the line, the more serious the effect. Failures not only require that locomotives run to another water station but also spell delays and disruptions of schedules. It is this active and admirable spirit, more than any other factor, that has enabled the railroad water servicing departments to meet today's demands. Facilities must be maintained in efficient operation to avoid delays; all new work must be planned and designed scientifically and executed in such a way that it will meet the needs of high-speed service.

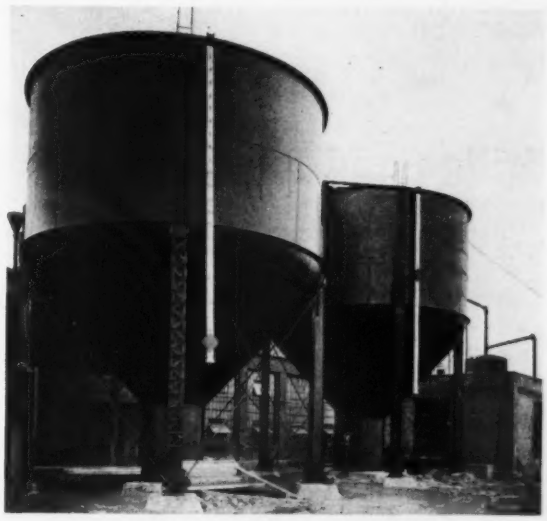
Committee—H. B. Christianson (chairman), div. engr., C.M.St.P. & P., LaCrosse, Wis.; J. S. Hancock (vice-chairman) bridge engr., D.T. & I., Dearborn, Mich.; R. C. Bardwell, supt. w.s., C. & O., Richmond, Va.; J. H. Bugg, supvr., w.s., C.N.R., London, Ont.; R. T. Burns, supvr. w.s., C. & N.W., Boone, Iowa; L. A. Cowsert, supvr. tests, B. & O., Dayton, Ohio; L. A. Davis, supvr. w.s., M.P., Osawatomie, Kan.; C. R. Knowles, supt. w.s., I.C., Chicago; J. H. McClure, b. & b. mast., C.N.R., Moncton, N.B.; J. W. Porter, prin. asst. engr., C.N.R., Winnipeg, Man.

Discussion

Opening the discussion of this report C. R. Knowles (I.C.) discussed the possibilities of achieving economy through the retirement of obsolete and unnecessary water stations and said that his road had retired 90 such stations in the last 10 years. R. C. Bardwell (C. & O.), continuing with this line of thought, said that on the Chicago division of his road the number of water stations had been reduced from 22 in 1922 to 8 at the present time, 2 of which are now closed down. Owing to the increased capacity of engine tenders it is now possible, he said, to place water stations an average of about 40 miles apart, whereas formerly they had to be placed at intervals of 12 or 15 miles. He declared that much that has been accomplished along this line has been done in the face of opposition by the operating department.

Describing the history of water treatment on the C. & O., Mr. Bardwell said that a campaign to improve water supplies was started on this road in 1922, this campaign being confined to the western portions of the system as it was felt that the supplies in eastern territory were satisfactory. However, while the treatment of water supplies in western territory was being accompanied by a marked reduction in pitting and corrosion of locomotive boilers and flues, complaints began to come in from "good water" territory, where the water, measured in accordance with previous standards, had formerly been considered satisfactory. As a consequence, he said, the treatment of water supplies was extended to the eastern territory during the last seven or eight years, with the result that about 85 per cent of all locomotive water used on the system is now treated.

J. S. Smith (L.V.), discussing the corrosion of stand pipes and valves where water supplies are treated, told of an instance on his road in which the valves of a standpipe that was being pulled down could not be closed because of corrosion. A. C. Sachs (C. N. R.) recounted a similar experience on his road, and said that the practice of the Canadian National is to overhaul standpipes thoroughly twice a year.



With Fewer Water Stations Larger Storage Capacity Is Necessary

Mr. Knowles said that some incrustation in pipe lines is to be expected where the water is treated, but declared that little difficulty with valves would be experienced if they are watched closely and cleaned properly. For the latter purpose several acid compounds are available, he said.

City Supplies

J. H. McClure (C.N.R.) described an installation on his road in which a city main carrying a pressure of 175 to 180 lb. per sq. in. was connected directly to a standpipe. This installation, he said, caused him some concern in the beginning as he was afraid that water-hammer might cause trouble. However, this difficulty did not materialize, even though no cushion valve was installed in the line. Speaking of city water supplies, Mr. Knowles said that few such supplies are capable of delivering water at a rate sufficient to service high speed trains, with the result that railroads

can utilize water supplies from city sources only where the demands are limited.

Elmer T. Howson *(Railway Engineering and Maintenance)* pointed to the great progress that has been made in water supply practice and treatment in recent years and said that this is symbolic of what is taking place in other departments of the railroads; nothing is static, everything is changing, he said. In observing present facilities, he continued, railroad men should be on the alert to detect those that are not in keeping with the latest developments and practices.

Mr. Howson cited a conversation with a division superintendent in which the latter recounted that a recommendation of his to the effect that 10 water stations on his division be retired was rejected on the basis that its acceptance would be a reflection on the engineers who built the stations. Later, in a conversation with the general manager of the same road, Mr. Howson was told that the railroad had effected considerable economies through the retirement of certain water stations, and it developed that the superintendent with whom the previous conversation was held had, on his own authority, taken some of the water stations on his division out of service for six months for the purpose of demonstrating that substantial savings could be effected in that manner, and had as a result secured authority for their abandonment.

While water stations that are now being installed are highly efficient and economical, continued Mr. Howson, progress is taking place with such rapidity that they will no doubt be replaced with still more efficient installations in the years to come. Economies effected through the removal of water stations, he added, should comprise a lesson that can be applied with corresponding results to other facilities.

Concluding the discussion of this report, Mr. Knowles called attention to the fact that savings in expenses also accrue to the operating department when water stations are removed.

Bridge and Building Supply Men's Exhibit

L. F. Flanagan
President

DEPARTING from a long-established custom of presenting their exhibits through catalogs, samples and models, 48 manufacturers of materials used in the construction and maintenance of railway bridges, buildings and water service facilities took advantage of the enlarged space available to present a comprehensive exhibit of their products under the auspices of the Bridge and Building Supply Men's Association. As a result, this exhibit was much more comprehensive, attractive and instructive to railway men than its predecessors.

The officers of the Bridge and Building Supply Men's Association who were responsible for the preparation and conduct of the exhibit this year were: President, L. F. Flanagan, representative, Detroit Graphite Company, Chicago; vice-president, C. E. Ward, U. S. Wind Engine & Pump Co., Batavia, Ill.; treasurer, K. T. Batchelder, manager railway sales, Insulite Company, Chicago; secretary, W. S. Carlisle, representative, National Lead Company, Chicago; honorary director, John W. Shoop, sales manager, The Lehon Company, Chicago; and the following members of the executive committee—George R. McVey, special representative, Ruberoid Company, Chicago; George W. Morrow, representative, Ingersoll-Rand Company, Chicago; Guy C. Mills, Zitterell-Mills Company, Webster City, Iowa; Earl A. Mann, Modern Supply Company, Chicago; Earl E. Thulin, Duff-Norton Manufacturing Company, Chicago; and C. C. Rausch, Dearborn Chemical Company, Chicago.

In the election of officers Mr. Batchelder was advanced to the presidency, Mr. Mann was elected vice-president; Harry A. Wolfe, The Lehon Company, Chicago, was elected treasurer; Mr. Carlisle was re-elected secretary; and Mr. Flanagan was made honorary member of the Executive committee. George W. Anderson, Patterson-Sargent Company, Chicago, was elected a member of the Executive committee to succeed Mr. McVey, and Mr. Morrow was re-elected to that committee.

A list of the exhibiting companies, together with the products on display and the names of the representatives are given below:

List of Exhibitors

Armstrong Paint & Varnish Works, Chicago; Tom Wyles.

Arrow Tools, Inc., Chicago; W. S. Holmes.

W. S. Carlisle
Secretary

Automatic Nut Company, Chicago; lock nut, and structural ribbed bolt; A. B. Cross and R. J. Voss.

Binks Manufacturing Company, Chicago; paint spraying equipment; R. E. Mann and E. F. Watts.

A. M. Byers Company, Pittsburgh, Pa.; literature on genuine wrought iron in railway applications; R. G. Angell, E. S. McCormick and W. J. Wignall.

Celotex Company, Chicago; insulation, wallboard, and cold storage insulation; J H. Bracken, W. S. Millener and H. A. Winandy.

Crane Company, Chicago; plumbing equipment for stations and other buildings, miscellaneous valves and fittings for steam, water, oil and gas service, and oil-fired fin-type steam and hot water heating boilers; E. T. Balluff, J. H. Gibson and F. W. Venton.

Dearborn Chemical Company, Chicago; rust preventives, sealing compound for

wood water tanks, aluminum protective coating for steel, pipe covering for underground pipes, water motor and chemical pump for proportioning feed-water treatment, and literature on water treatment; D. Bodishbaugh, L. D. Brown, R. A. Carr, J. A. Crenner, H. B. Crocker, W. H. Hinsch, F. B. Horstmann, H. C. Moeller and C. C. Rausch.

Detroit Graphite Company, Detroit, Mich.; bridge paints, building paints; L. F. Flanagan and E. C. Roberts.

Detroit Steel Products Company, Detroit, Mich.; steel windows, photograph of bonderizing plant, steel roof deck, and steel floor forms; R. S. Bishop, William Gillett and H. E. Heseltine.

Paul Dickinson, Inc., Chicago; roof ventilators, smoke jacks, stove jacks, roof drains, and exhaust heads; Paul Christiansen, A. J. Filkins and William Harrison.

Joseph Dixon Crucible Company, Jersey City, N. J.; graphite paints, aluminum paints, waterproof grease for cables, and cup grease for turntables; E. C. Bleam.

The Duff-Norton Manufacturing Company, Pittsburgh, Pa.; C. N. Thulin and E. E. Thulin.

E. I. DuPont de Nemours & Co., Wilmington, Del.; J. Agan, F. H. Crawford, R. J. Knox, L. Ritchie, W. Soshea, P. White and E. L. Younger.

Fairmont Railway Motors, Inc., Fairmont, Minn.; motor cars; Kenneth Cavins, V. Pagett, W. H. Ripken and J. E. Simkins.

Graver Tank & Manufacturing Company, East Chicago, Ind.; chemical tank and appurtenances; J. J. Felsecker and E. W. Welp.

Hastings Signal & Equipment Company, Boston, Mass.; clearance warnings; R. W. Hastings and Barton Snow.

Homelite Corporation, Port Chester, N. Y.; portable pumps, generators, blowers, small portable compressors; A. G. Straetz.

B. E. Hurlbut, Chicago; self-priming centrifugal pumps, paint spray equipment, power timber saws, and portable a-c. power plants; B. E. Hurlbut.

Ingersoll-Rand Company, New York; literature on compressors, pneumatic tools, jack-hammers, rock drills, hoists, sump pumps and pumps; G. W. Morrow and K. I. Thompson.

Ingot Iron Railway Products Company, Middletown, Ohio; bonded metal, metal cribbing and literature on spiral pipe, rapid action air line coupler, automatic drainage gate, and sample of multi-plate construction; W. P. Greenawalt and J. L. Young.

Insulite Company, Minneapolis, Minn.; building insulation, cold storage insulation, combination insulation and building sheathing, insulating plaster base lath, roof insulation, tile and plank, and hard board products; K. T. Batchelder, C. S. Johnston and C. P. Larson.

Johns-Manville Sales Corporation, New York; samples of Transite pipe, corrugated Transite roofing and siding, asbestos roofing and siding shingles, Transite conduit asphalt tile flooring, asphalt shingles, built-up roofing, prepared roofing, pipe insulation, asbestos wainscoting and wallboard, mechanical packing, and asphalt plank; T. O'Leary, Jr., H. R. Poulson, W. W. Prosser, F. C. Vandervort and L. T. Youhn.

Joyce-Cridland Company, Dayton, Ohio; screw jacks, hydraulic jacks, ratchet jacks, push and pull jacks, trench braces, air-motor jacks, journal jacks, and pole jacks; E. A. Mann, Merle P. Smith, A. A. Walker and W. F. Weber.

Koppers Company (Tar and Chemical division), Pittsburgh, Pa.; literature on roofing, waterproofing and tar products; H. L. Stockdale.

Lehon Company, Chicago; asphalt shingles, asbestos shingles, prepared and built-up roofing, aluminum roofing paint, and waterproofing materials; John Eipper, Tom Lehon, R. J. Mulrooney, John W. Shoop and Harry Wolfe.

Lewis Bolt & Nut Company, Minneapolis, Minn.; hook bolt, timber bolt, guard-rail bolt, guard-rail lag bolt, and ferry cribbing bolt; R. B. Hill and H. W. Johnson.

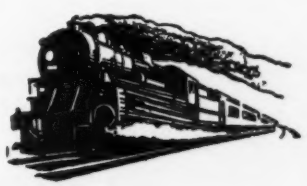
Mall Tool Company, Chicago; gas-driven and electric-driven machines for vibrating concrete and surfacing concrete, with attachments for grinding, pumping water, drilling, boring, driving lag screws, wire scratch brushing and sanding; Robert Burgwald, A. W. Mall, F. A. McGonigle and M. Rehnquist.

Massey Concrete Products Corporation, Chicago; literature on and photographs of concrete pipe, concrete cribbing and crossing slabs; Ross Clarke, Charles Gilman and David A. Hultgren.

Master Builders Company, Cleveland, Ohio; samples of floor wearing surfaces, rust joint iron, non-shrink aggregate for concrete bonds, reground portland cement paint for concrete surfaces, liquid quick-setting compound, and puzzolanic water-reducing agent for mass concrete; F. R. Hinds, M. Stone and B. R. Wood.

Modern Supply Company, Chicago; bridge reamers and small bridge tools, copper pipe and soldered pipe fittings, bridge augers, timber hole feeders; Earle A. Mann, R. E. Mann, A. A. Walker and W. F. Weber.

Morrison Railway Supply Corporation, Buffalo, N. Y.; samples of structural welding, sample poles treated with Osmose, and literature on welding frogs and crossings; George W. B. Diver, Marion Morrison, Raymond L. Morrison and W. F. Pickham.



National Lead Company, New York; red lead, white lead, expansion bolts, and linseed oil; J. O. W. Belt, W. S. Carlisle, O. Meyer and Hugh M. Millen.

Otley Paint Manufacturing Company, Chicago; paint panels; E. O. Otley, Walter A. Otley and E. B. Van Patten.

Oxweld Railroad Service Company, Chicago; motor car headlight, samples of welded pipe, soldering and brazing outfit, complete welding and cutting outfit; Lem Adams, D. H. Pittman, J. C. Stephenson and F. C. Teichen.

Patterson-Sargent Company, Chicago; bridge paints, and literature on bridge paints; W. H. McBride.

W. W. Patterson Company, Pittsburgh, Pa.; wood tackle blocks, and steamboat ratchet; W. W. Patterson, Jr.

Pittsburgh Plate Glass Company (Paint and Varnish Division), Newark, N. J.; paints and waterproofing; J. G. Mowry.

Pocket List of Railroad Officials, New York; copies of publication; B. J. Wilson.

Railway Engineering and Maintenance, Chicago; copies of publication; George E. Boyd, M. H. Dick, L. R. Gurley, S. W. Hickey, Elmer T. Howson, W. S. Lacher and H. A. Morrison.

The Ruberoid Company (Railroad Division), Chicago; mineral wool insulation, pipe covering, asbestos shingles, roofing and siding, 85 per cent magnesia insulation, asphalt shingles, and prepared roofing; T. M. Dantz and G. R. McVay.

T. W. Snow Construction Company, Chicago; T. S. Daniels and Barton S. Snow.

Thompson & Co., Oakmont, Pa.; test of paint panels, metal paints and rust inhibitor, and model of steel truss; J. L. Crowley, J. Laird de Vou, Jr., and D. D. Monroe.

Timber Engineering Company, Washington, D. C., timber connectors, model of timber trestle, models of roof trusses, full-sized timber-connector joints, and literature on connectors and timber design; Ira D. C. Kelly.

United States Gypsum Company, Chicago; interior and masonry paints, asphalt roofing, gypsum and steel decks, asbestos products, board and glass-fibre insulating wool insulation, expanded metal and metal lath products, lime, gypsum wallboard, fibre wallboard, lime products, plaster products, asbestos siding, cromite metal tile, asphalt shingles, asphalt roofing, pipe insulation, boiler lagging, sound insulation and asbestos packing; S. N. Havlick, C. W. Marshall, H. L. Miller, N. G. Nieman and John C. Stewart.

U. S. Wind Engine & Pump Company, Batavia, Ill.; model water tank with steel tower, valves, water column parts, water service equipment, and literature; J. P. Prindle and C. E. Ward.

Yale & Towne Manufacturing Company, Philadelphia, Pa.; chain hoists, pull-lift hoist, literature on hoisting and pulling; R. J. Arehart.

Zitterell-Mills Company, Webster City, Iowa; Guy C. Mills.

What's the Answer?

Should Rail Be Precurved?

What advantages, if any, are there in precurving rail? What disadvantages? What effect do the weight of the rail and the degree of curvature have?

Precurving Not Logical

By Bernard Blum
Chief Engineer, Northern Pacific, St. Paul, Minn.

Primarily, the objection to precurving rails is that, no matter what type of bender is used, precurving consists of kinking the rail laterally at intervals along its length, which means that the metal of the rail has been stressed beyond its elastic limit at several points. When we recall the care taken at the mill to avoid excessive gagging, and in the field to avoid kinks from dropping the rail when unloading, it seems hardly logical deliberately to introduce kinks later on.

Precurving is quite expensive and, by reason of their different degrees of ductility, no two rails will take exactly the same curve with one setting of the machine. A bender set to curve a rail having a high degree of stiffness may, and frequently does, put too much curve in a more-ductile rail.

After observing curves up to 10 deg., some having precurved rail and others having rail that had not been precurved, I have been unable to distinguish any difference in their behavior. I have come to believe, therefore, that there are no advantages in precurving rail and that the practice possesses the disadvantages which have been mentioned.

Sees No Advantages

By I. H. Schram
Engineer Maintenance of Way, Erie, New York

There are no advantages in precurving rail that is to be laid on curves of radii that are found ordinarily in main-line tracks. Experience has shown that the new rail adjusts itself readily to the curvature of the track as it is laid, and that it takes a uniform set which conforms to the radius of the curve. When this rail is removed from the track after a period of service, this set for the curvature is quite noticeable through the reaction that sets in and the bend that the rail displays, this being substantially the same for all of the rail sections in common use up to the 131-lb. A.R.E.A. design. Efforts in the past to precurve rail have not been uniformly successful and have generally resulted in kinks in the rail, have distorted the line and have often started irregular side wear.

Demanded by Poor Joints

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

It has been only a few years since the precurving of rails was universal, and every supervisor and most foremen carried a table of ordinates for rails of the lengths then in use. It is of interest that for many years no equipment other than a push car or a crib of ties was considered necessary for the precurving operation. This was carried out by lifting one end of the rail onto the push car or tie crib, laying it on its side, and at the same time making certain that the other end rested on a tie in the track. The section gang then stood on the rail, distributing themselves about evenly along its length, and sprang up and down in unison until the proper curvature had been obtained. If done skillfully, the curvature was smooth and uniform; if unskillfully, the rail might be spoiled.

When this practice came into vogue, joint bars had so little lateral stiffness that the rail ends could not be held in place unless the rail was precurved. But as joint designs were improved, the practice was discontinued gradually, beginning with the lighter curves,

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in January

1. To whom should the operators of roadway machines report? Why? Does the type of machine or the class of work it is doing make any difference?

2. Is it preferable to provide superelevation in the bents of a ballast-deck trestle, or should this be done with the ballast? Why? Should there be a limit to the maximum or minimum elevation in either? Why? If so, what should this limit be?

3. How should a gang engaged in building up battered rail ends be organized to insure a properly balanced operation?

4. Is it practicable to extend at relatively small cost the life of a slate or tile roof which has begun to disintegrate? A metal roof? If so, how?

5. What special steps should section forces take to insure against accidents at grade crossings during the winter?

6. What causes leakage between the staves of wooden tanks? How can it be stopped?

7. Is there any special merit in daily track patrol during the winter, as compared with other seasons of the year? If so, what? If not, why?

8. Is it practicable to have bridge and building painting done locally by contractors? What are the advantages? The disadvantages?

until today it is generally confined to sharp curves, bridges, tunnels and special requirements of complicated track layouts. With present joint designs and heat-treated bolts, any section of rail can be lined accurately to uniform curvature on any curve that is likely to be encountered in main-line track with the exceptions that have already been noted. Furthermore, where this has been done no trouble will be experienced with the joints, that could be eliminated by precurving the rail.

Sees Advantages

By Thor Monrad
Track Supervisor, Northern Pacific, Columbus, Mont.

There is a decided advantage in precurving rails for sharp curves, although there is little point in doing this for light curves. Precurving should be done by a power-driven roller bender in a shop where the operation can be controlled. No bending equipment designed for use in the field is susceptible of sufficient control to insure smooth uniform curvature to the proper radius, while attempts to curve rails with such devices are more likely to result in a series of kinks which will make accurate lining difficult, if not impossible. Rails of heavy section are stiffer and correspondingly more difficult to curve smoothly than those of lighter weight.

Practice Dying Out

By C. W. Baldridge
Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

It was formerly the general practice to precurve rails, and most books on track maintenance contained tables of middle ordinates for various lengths of rails and various degrees of curvature. Experience gradually brought to light certain faults resulting from precurving, however, and also proved that the precurving of rails is unnecessary.

Among the faults that were developed were frequent damage to rails by the rollers of the rail curver, which often became rough from use and, in some cases, nicked. Nicks in the rails, which caused them to break, resulted from nicks in the rollers. Another fault was that the curving could not be carried to the ends of the rails, for it could not commence until all three of the rolls of the curver came into contact with the rail. Likewise the curving stopped as soon as the front roller reached the end of the rail. As a result, the rail was straight through the joints, and curved over the remainder of its length.

Experience also disclosed that the cold rolling of the rails by the car and locomotive wheels, compacts the metal along the gage side of the rail head, causing the rails to curve around the gage side. In this way, the curvature of the outside rail is increased, while that of the inside rail reverses itself as soon as it is released from the track. This proved that precurved rails do not stay curved. Furthermore, it was found that rails laid without precurving give better and more uniform line, provided the joint bars are applied correctly and all bolts are tightened before spiking is attempted.

The tendency of the low rails to reverse their curvature when they are released from the track is greater in light than heavy sections, the reason for this being that a larger percentage of the metal in the head of the light rail is affected by the compressive action of the wheels. On the other hand, the danger of damaging heavy sections is greater, since more force must be applied in the curving of these rails, with greater risk of nicks and other damage to the metail.

Without precurving, 130-lb. rails laid on a 10-deg. 30-min. curve, have been lined more accurately than has been possible with prevurved rails of any section, primarily, if not entirely, because there were no straight spots through the joints. Thus, experience shows that there are no advantages in precurving rail, but that there are the several disadvantages which make the practice undesirable in many respects.

Steam Versus Hot Water

What are the relative advantages and disadvantages of steam and hot water for heating small and medium-sized stations? Large stations? Why?

About Equal

By D. T. Mack
Architect, Delaware, Lackawanna & Western, Hoboken, N.J.

Formerly hot water, as a medium for heating small or medium-sized buildings, including passenger stations, signal towers, offices in freight houses, etc., possessed two principal advantages, compared with steam, but these have been largely overcome by improvements made in steam-heating devices and methods in recent years. The first of these is the simple automatic vacuum valves now available, which can be used with either the two-pipe or the single-pipe systems of steam heating, to give the same flexibility of control that was formerly enjoyed exclusively by hot water. This flexibility provides the same comfort and permits the same economy of operation that was formerly obtainable only with hot water. These valves make it possible to use smaller radiators and simpler piping than is required for hot water, for which reason the initial cost, that of installation, is considerably below that for a hot-water system.

The only other important advantage formerly possessed by hot water was that the plant could be set at the same level as the radiators. Even this advantage, except for the very smallest heating plant, has been overcome largely by the use of unit heaters. Where it is possible to use the boiler itself to provide a part of the radiation, there is still a slight advantage in favor of hot water; otherwise the advantages are all with steam. This is also true of large stations for the same reasons that have been given for smaller buildings. There is also a further reason—where generating plants are operated or there is a large consumption of steam for other power requirements, the exhaust steam can be used with considerable economy for heating.

Covers Wide Field

By F. R. Judd
Engineer of Buildings, Illinois Central, Chicago

This question, as it is asked, covers a wide field, for the range from small to large stations can well include substantially all of the heating problems encountered in railway buildings, with the exception of shops and engine houses. Small stations requiring 500 sq. ft. or less of direct radiation can be heated better with hot water, because the boiler and radiators can be placed on the same floor level, thus eliminating the necessity for a depressed pit or a basement.

Larger direct systems, up to 2,000 sq. ft. for hot water or 1,200 sq. ft. for steam, can be used with either of these media with the same results in effectiveness and economy, if the boiler is placed in a depressed pit or a basement. If the former, the hot

water system will work under gravity, but it will be necessary to return the condensation from the steam plant to the boiler by mechanical means. If in a basement, both types of plants will operate under gravity.

Hot-water plants can be operated with the boiler at floor level if circulation is maintained by pumps. Plants requiring more than 2,000 sq. ft. of hot-water radiation or 1,200 sq. ft. of steam radiation, necessitate the handling of such large amounts of coal that the boilers must be placed in a basement, or in a specially designed boiler room, with provision for sufficient coal storage to carry over a full heating season. A basement is not essential if mechanical means are employed to circulate the water in a hot-water system or to return the condensate from a steam plant to the boiler.

At the larger stations it is generally necessary to provide steam for purposes other than heating, in which event it is usually more desirable to enlarge the plant to meet all requirements. Considering the relative advantages and disadvantages, hot water has a distinct advantage over steam, where it is practicable to use it, since it can be controlled at the boiler plant to correspond with varying external temperatures. On the other hand, steam heat must be regulated in the individual rooms by either manual operation of the radiator valves or automatic temperature-control apparatus. In assessing the advantages and disadvantages of these two systems, it should not be overlooked that a hot-water plant will be damaged to a far greater extent from freezing than a steam plant. However, the foregoing discussion is based on the assumption that the heating plant will receive proper attention at all times.

Assistant Foremen in Yards

Should a yard gang include one or more assistant foremen? Why? If so, how many? What should be their duties?

Is an Asset

By W. E. Folks

Track Supervisor, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio

In general, modern yards are supervised more consistently than was formerly the practice, and in a yard of any size or importance it is almost necessary that assistant foremen be assigned. The foreman usually has many duties other than those of supervising directly all of the work his gang, or detached units of the gang, may be called upon to perform. Obviously, detached units of three to six or eight men require supervision as definitely as a regular gang of equal size, and there should be enough assistant foremen in the gang to handle the normal number of detached jobs which come up in any yard day by day.

The number of assistant foremen that should be assigned will depend on the size of the yard and its design, the volume of traffic passing through it, and other factors which differ widely between roads and even between localities on individual roads. The number should be sufficient, however, to insure adequate supervision not only of the work in the yard taken as a whole, but of the multitude of individual tasks which must be given attention in a busy yard. This is a matter which must be considered individually for individual yards, for which reason it is impracticable to discuss it except in the most general terms. The one rule that should govern is to develop the organization that will get the desired results in the most effective and economical way.

In general an assistant foreman is an asset in any yard large enough to require a yard gang. Additional assistant foremen should be assigned as the size of the yard, and incidentally of the gang, increases. In the first place, few foremen, no matter how able they may be elsewhere, are capable of maintaining a yard until they have had considerable yard experience. Assistant foremen, therefore, provide a reservoir from which yard foremen can be drawn when necessity arises.

Decided Against It

By F. J. Bishop

Engineer Maintenance of Way, Toledo Terminal, Toledo, Ohio

On many occasions we have considered placing assistant foremen in yard gangs, but after careful analysis of each yard the decision has been against their use. If the number of men in the gang is too large for the majority of the tasks required of the gang, obviously an assistant foreman should be assigned to split the gang into smaller units to perform small jobs.

Every yard seems to have its special problems and to determine the most economical organization, a careful and unbiased analysis should be made of the actual work the gang is called upon to perform. Great economies can be effected by assigning the proper number of men, not forgetting the proper supervision, to each particular piece of work that the gang has to do.

Supervision Pays

By District Engineer

It has been said with a great deal of truth, that a railway gets a larger return on the money its spends for supervision than from any other expenditure it makes. So long as the supervision is not out of proportion to the force employed, this statement holds true. It can be applied with a great deal of emphasis to yards of such size that yard gangs are employed, where lack of supervision may be extremely costly, not only from the standpoint of maintenance, but with respect to the movement of traffic.

A yard foreman has a multitude of duties, some of which make it impracticable for him to spend all of his time with the gang, and in some cases very little of it. Obviously, when he is not present with his men, he should have someone who can assume responsibility for the quality and quantity of work turned out by the gang. Logically, this should be an assistant foreman. In any busy yard there are usually several jobs that must be done simultaneously. For those jobs where only one man, or at most two, is needed, the foreman should, and usually does, have one or more reliable men who can be sent out alone or together to make needed repairs. Where the character or importance of the work is such that more men are needed, they should be sent out under competent supervision and, again, logically, in charge of an assistant foreman.

Furthermore, competent yard foremen have never been very plentiful, since yard maintenance requires careful management. To be a successful yard foreman one must have ability to sense the relative importance of various jobs when several calls are received at about the same time; an alert and ready willingness to revise plans and concentrate or redistribute forces to meet constantly changing conditions of yard operation; and sufficient strength of character to prevent abuses of this willingness. He must constantly exercise diplomacy to keep

on good terms with yard men who are sometimes at their wit's end to keep traffic moving smoothly and consistently.

It is evident that a yard foreman must be not only a good trackman who specializes in turnout work, but he must be able to organize and direct somewhat widely scattered units of varying size. He must also be able to get along with and command the respect of busy men who will not hesitate to run over him if he shows the least sign of weakness in this respect. The best place for a man to get the experience that will qualify him for the important position of yard foreman, is training in the position of assistant foreman.

How many assistant foremen should there be? This will depend entirely on the size of the yard, the way it is laid out, how it is operated, its general physical condition and numerous other factors. About the only thing that can be said on this phase of the subject is that there should be a sufficient number of assistant foremen, whether it be one or a dozen, to insure the best and most economical, not the lowest cost, supervision. This can be determined only after a careful study of the yard and its maintenance requirements.

Should They Be Insulated?

Should roadway machines, such as ballast discers, weed burners, light cranes and similar equipment, that are assigned to work all or part of their time in automatic signal territory, be insulated? Why?

Should Be Insulated

By W. L. Roller
Division Engineer, Chesapeake & Ohio, Columbus, Ohio

All light equipment, such as hand and motor cars, air compressors mounted on standard-gage trucks, small cranes and similar equipment should be insulated, not only for use in automatic-signal territory, but also where crossing signals and interlockings occur. We have had cases where non-insulated machines, and equipment upon which the insulation had become defective, have shunted the circuits in interlockings, causing delay to trains and interference with the operation of the plant. A potential hazard to train operation is created when such equipment is not insulated. The same is true of weed burners, discers, light cranes, motor cars, etc., which are customarily insulated.

Equipment of these types should be insulated primarily as a means of safeguarding the operation of trains by preventing the indiscriminate use of automatic-block protection for equipment for which this protection has never been intended. Automatic-block signals are invariably installed for the protection of train movements and for the safety of those who travel by rail, and no machine or other form of equipment that will interfere with this purpose should be intruded upon the rails.

Furthermore, these machines should be insulated for their own protection and that of those charged with their operation. All or most of them are fitted with take-off devices to permit clearing the track quickly for train movements. Operating instructions are practically unanimous that the tracks must be cleared well in advance of trains. For this reason, positive instructions to all of those in charge of the operation of such equipment should not be nullified or rendered ineffective by providing the doubtful security of signal protection. In the use of light equipment of the classes under discussion, there is no positive assurance that automatic signals will provide protection, since it often occurs that such equipment will not shunt the track circuit, in which case a false sense of security is engendered in those using the equipment.

Depends on Type and Size

By A. E. Perlman
Engineer Maintenance of Way, Denver & Rio Grande Western, Denver, Colo.

Roadway machines, such as ballast discers, weed burners, light cranes and heavy-duty inspection motor cars, usually represent individually a substantial investment, and their movements on the main tracks should be surrounded with maximum protection. However, certain of these machines can be removed readily from the rails, and are usually operated on line-ups and under flag protection. I believe that, to prevent delays to trains, such equipment should be insulated so that in A.P.B. territory a train may come to the flagging limits without being stopped by a number of signals, and the machine may be worked a substantially longer time without delaying trains.

It is my thought, therefore, that machines which cannot be removed readily from the rails should not be insulated, but that all machines that can be removed readily should be insulated. This will give maximum protection to these machines which are in greatest need of protection, and will permit other machines to be used with the minimum delay to traffic.

Believes in Insulation

By Engineer Maintenance of Way

We have studied this subject recently and have reached the conclusion that machines of the classes mentioned are not heavy enough to insure dependable operation of block signals. We consider that when we do not know definitely that a non-insulated machine will set a signal and hold it positively at the stop position to provide the desired protection, it will be better, from the standpoint of safe operation, to insulate it and know definitely that no block-signal protection is being afforded.

Frequently these machines work for considerable periods in the circuits of a certain few of the block signals. To the extent that non-insulated machines operate the signals, there will be a drain on the batteries which provide the lighting and actuate the signal devices. It is estimated that such a machine, occupying a track circuit for a full working day, might use as much current as will be required for a month or more of ordinary train operation.

Should Operate Signals

By I. H. Schram
Engineer Maintenance of Way, Erie, New York

Roadway machines of the heavier types should not be insulated, whether they do or do not work in automatic-signal territory. Machines that will affect track circuits must of necessity be protected by flagging and the operation of the circuits by the machines affords protection in addition to that of hand flagging. If for any reason, the latter should not be effective, undesirable stops of trains are not increased, if the maintenance equipment is handled properly, that is, if it is cleared promptly on the time of trains, is not allowed to foul the main track when in on sidings, and if the skids or other apparatus for taking the equipment off of the track are removed from the track promptly.

Insulation on heavy machines is difficult to maintain properly and may

cause considerable expense if applied to them. It is also desirable that these machines be in condition to operate automatic crossing protection devices, even though every precaution is taken to operate them safely over grade crossings.

Signals May Not Respond

By Earl H. Mills
General Gas Engine Inspector, New York Central, New York

All work equipment having flanged wheels for running on the track, but not meeting M.C.B. specifications, should be insulated. Signal circuits are of low voltage, feeding a fixed amount of current into one end of the track circuit through the rails to an energized relay at the other end. Enough of this low-voltage current must be shunted through the wheels of the equipment to de-energize the relay which, on its release, gives the signal indication. Unless the equipment has enough weight to do this *unfailingly,* the signal apparatus will not always respond. It is well known that light equipment will not always work the signals, and where there is doubt, the only safe procedure is to insulate the wheels and not depend on uncertain signal protection.

Other factors have a bearing on the need for insulation. One of these is that the uncertain contact of light equipment is apt to disarrange the signal apparatus in such a way as to interfere with traffic. Another is that most of the work equipment under discussion has a short wheel base and can stand in the space between the staggered insulated joints of the opposite rails where it is off of both block circuits. This sets up an unsafe condition if dependence is being placed on signal protection. Dirt, oil, rust, paint, etc., on the wheels or the running surface of the rail, a condition often met, will prevent a good contact. The only assurance of safe operation is to insulate the wheels and not depend on signal protection.

Fluctuations in Water Stages

Where the variation between the high and low-water stages in a stream are much greater than the practical suction lift, how should the pumps be located? What precautions are required?

A Number of Ways

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

A number of schemes have been developed for solving the problem resulting from this condition. It is always desirable to have the power end of the pump located above high water, whether it be operated by direct motor drive, by a belt drive from a motor or gasoline engine or by steam. Where the pumps are of the plunger type, such as the single or double-acting triplex, the manufacturer will furnish a special design where all of the working mechanism, except the water section, is placed on a platform above extreme high water. The valves and pistons are then set within the proper suction lift of extreme low water, and are connected to the operating mechanism by means of steel rods moving between roller guides, which are set at reasonable supporting distances to prevent displaced alinement during the compression stroke.

Although the water box and valves may be operating under water a good share of the time, this will do no serious harm if suitable provision has been made by screens or other devices to prevent debris from entering the water openings of the pump. This plan involves the construction of an operating tower in the channel of the stream or an open-type well on the shore line, with an intake connection extending to the river for use at low-water stage.

In some places where neither a tower nor a well is used, a skidway, anchored permanently in place on the sloping bank of the stream, is provided and on this the complete pumping unit is raised or lowered gradually as necessary, by means of a windlass. By this means the pump is kept within proper suction lift of the water without being flooded. This also involves the use of flexible connections between the pump and the permanent discharge line.

Since the development of the turbine pump, arrangements such as have already been referred to are usually taken care of more effectively by placing the pump with the bowls below low-water level so that they will be completely submerged at all times. This type of pump must also be set in a tower or well connecting with the river. Fluctuations in the water stage will then cause practically no change in operating conditions, other than slight variations in the power requirement.

Prefers Pump Pits

By J. H. Davidson
Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

Under the conditions cited, the most satisfactory method of locating the pumps is to place them on the floor of a water-tight pump well or pit, of sufficient depth so that at the lowest level of the water supply, they will have a practicable suction lift. Obviously, the top of the pit should be above flood stage to insure uninterrupted service. There are such installations on American roads where the variation in the river stage is as much as 75 ft. The first cost of these water-tight pump pits is high, but as insurance against interruption of the water supply at important water stations, it is fully warranted.

Care must be exercised in selecting the pumping equipment to provide maximum efficiency under normal operating conditions, at the same time guarding against overloading the power unit at times when the water stage is high and the suction line is working under positive head. Various types of pumps and of power units can be used in such a pit. If steam pumps are desired, the size of the pit can be made to accommodate them, but the steam generating plant should be outside of the pit above high water.

Electrically driven centrifugal pumps are specially adapted for installations of this kind, owing to the small space they occupy, compared with other types. Those selected should, however, be so designed as not to overload the motors at high-water stages. Variable-speed motors can be used advantageously to avoid overloading and maintain efficiency under varying suction lifts. Since it is practically impossible to exclude all seepage from a pit of this kind, it is good practice to install a sump and a small sump pump, independent of the main units, to remove any water that may accumulate in the pit.

Often, the expense of constructing a water-tight pit can be avoided by installing a deep-well turbine type of pump. These are usually mounted on a platform above flood stage, which is supported on piling driven into the bottom of the stream or reservoir. If the characteristics of the stream are such that the deep-well turbine cannot be safely mounted on piling driven into the bottom, a small suction well can be constructed at a suitable dis-

tance back from the shore line, and water can be brought to it through a flow line. While these deep-well turbines cost more than some others of equal capacity and efficiency, this is more than offset in many cases by the saving which results from avoiding the construction of an expensive pit.

Gas Versus Electric Welding

What are the relative merits of gas and electric welding for structural repairs?

Enough Is Known

By Assistant Engineer of Bridges

While the art of welding, as applied to the repairing of steel structures, is of such recent origin that one must be cautious in making statements about it, enough information has been collected to insure that this method of making repairs is entirely feasible and safe, provided certain well-defined rules which have been developed from experience, are followed consistently. One of these is that, in making a weld, the practical minimum volume of base metal should be heated to the high temperature that is an inherent requirement of the welding process.

Arc welding fulfills this requirement, for the high temperature of the arc raises the metal at the surface to the fusion point before the heat can be carried to much depth by conduction. On the other hand, the gas process is so much slower that a relatively large volume of base metal must be heated before the surface temperature reaches the fusion point. If the base metal is not under stress the heating from the gas torch is not likely to cause damage, unless the section is very thin and unable to withstand buckling of the expanded metal, but if the metal is under stress, as it is likely to be when incorporated in a structure, the heating may cause permanent distortion, a thing that should be avoided by all means.

May Be Different Tomorrow

By General Inspector of Bridges

Welding has been used in repairing steel structures for so short a time that the art, with respect to this application at least, may be said to be in its early infancy. For this reason, one can scarcely predict what future developments will be, since they are being made so rapidly that the practices of today may be obsolete tomorrow, and disadvantages today may be advantages tomorrow. Obviously, however, certain basic principles are beginning to emerge; otherwise there could be no assurance of dependability and it would be highly undesirable to do welding on structures involving the safety of trains.

One of these principles is that to make a gas weld, a considerable volume of the metail in the member under repair must be heated to a high temperature, while arc welding can be done so much more quickly that only a shallow depth over a small area need be heated. This is the principal advantage of arc welding over gas welding for structural repairs, for most of these repairs must be made on members while they are under stress, and the greater amount of heat that must be applied may create danger of warping and permanent distortion, with resulting stresses than cannot be computed or controlled. On the other hand, gas welding can be done safely if the member can be relieved of all stress, a thing that can seldom be accomplished in a structure that must be kept in service while the repairs are under way.

When to Look After Rail Joints

Is it advisable to require section forces to devote certain days each week or month to the maintenance of rail joints? Why? What are the advantages? The disadvantages?

Did Use This System

By Geo. M. O'Rourke
District Engineer, Illinois Central, Chicago

For many years it was our practice to devote one day each month to tightening joint bolts. Since this did not prove to be satisfactory, the practice was discontinued and instructions were issued that bolts were to be kept tight and spikes in proper position at all times. As a result, more time was devoted to tightening bolts, but not on certain days. Better materials in bolts, nuts, and spring washers have reduced the amount of time required to keep bolts tight and the more recent development of power bolt tighteners has, to a larger extent, done away with hand work for this operation.

When practically all surfacing was done by section gangs, it was necessary that certain days be spent in picking up low joints; that is, the gangs would surface track four days and pick up joints two days or five days and one day, respectively, depending on the age of the rail, the condition of the ballast, etc. Now that so much out-of-face surfacing is being done with special gangs and power equipment, with section gangs reduced to the mainimum number of trackmen consistent with the routine duties they must perform, the joints are picked up when this becomes necessary, regardless of assigned days. Again, better material and better design in joint bars, the hardening of rail ends, surface welding, butt welding, and the use of reformed crowned bars and joint shims, are all combining to reduce the time formerly required for joint maintenance.

There is always an advantage in systematizing ones work, and in the assurance that the time being devoted to certain tasks will not be interrupted by outside calls. The disadvantage in such a system is the likelihood that the joints may be damaged while waiting for the schedule.

Believes in System

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

I am a firm believer in system and organization for handling every kind of work, and consider that they are particularly important in maintenance work. Maintenance forces are scattered so widely that they cannot be supervised closely, as the forces in

a shop or yard can, for which reason there is greater need for an organization that will function under the less rigid supervision; this can be done only by introducing system into their work, to insure that it will be done in an orderly manner.

Yet it should be recognized that there is an ever-present danger of over organization or of too much system, or both, which may result in loss of effectiveness and economy in carrying out the work of the district or division. I have known roadmasters and even division engineers, who so organized their work that every gang on the territory was expected to do the same kind of work at the same time; that is, on certain days all gangs were engaged in cutting weeds, surfacing track, putting in ties or doing other classes of work in accordance with a prepared schedule.

Unfortunately this basic plan is still being carried out to a greater extent than most of us realize, in most cases, perhaps, not so rigidly as outlined, but closely enough to reduce the effectiveness of not a few gangs. Obviously a foreman who has new rail and new ballast does not need to spend as much time on joint maintenance as is necessary on a section with worn rail and ballast that has been allowed to run beyond the date when it should have been renewed. Again, during the last few years, sections have been lengthened and the larger routine tasks have been taken over by specialized gangs, leaving the section gangs as little more than policing units that must do the urgent things first, allowing the tightening of bolts, the wholesale replacement of worn joint bars, the insertion of joint shims and the welding of rail ends to be done by system or division gangs.

Yet despite these changes in conditions and organization, I believe that it is still a good system to require the section gang to devote one day a week to going over its section to pick up joints, watch for loose bolts and do such other work as the condition of the joints demands. As long as we have joints they will require maintenance and for best results they should be looked after systematically.

Keeping Painting Records

Is it worth while to keep records of painting jobs on buildings? On bridges? Who should keep them? Where? What information should they contain?

Thinks Them Necessary

By R. E. Caudle

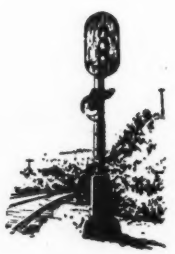
Assistant Engineer of Structures, Missouri Pacific Lines, Houston, Tex.

Since it has become the practice on many roads to purchase bridge and building paints on competitive bidding in the open market, it has become necessary as well as advisable to keep complete records of paint jobs on all structures. They should be made in duplicate by the foreman who applies the paint. The original should be sent to the supervisor of bridges and buildings and the duplicate to the division engineer.

Reports should be made for individual structures and each one should contain a clear record of the materials used in each of the coats applied on every job of any magnitude. The information should include the identification number or mark of the manufacturer, the date the paint was received, its condition when the container was opened, and the kind and quality of thinner or dryer added to obtain a proper consistency for application. The condition of the surface on which the paint was applied should be noted, and whether it was applied over old paint.

With this information, the supervisor or division engineer can easily trace the origin of either good or bad paint and be in a position to keep the purchasing department fully informed as to which manufacturers products give the best results. Supervisory officers will also be in a position to determine whether faulty materials, improper mixtures and surface conditions contribute to paint failures.

Large structures, particularly of steel, should be stenciled with the date of application of each coat, and the name and identification marks of the manufacturer. This should be done at some convenient but inconspicuous place, primarily for information when inspections are made.



Well, I Guess

By Dave Kirkland

Bridge and Building Department, Chicago, Rock Island & Pacific, Fairbury, Neb.

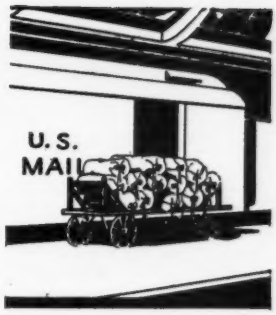
"Well, I guess . . .," is the way most requests for information start when no reliable records containing the desired data are available. Guess work affords no means of controlling quality or costs, or possibility of checking accurately the results of any operation. Painting is no exception, and to realize the full benefits of paint applications it is necessary to control both the method and the results. Painting is a major item in bridge and building maintenance, not only because of its cost, which in normal times runs into millions of dollars annually, but because of the importance of the appearance of well-painted buildings, and of the protective value against deterioration of paint.

For these reasons, a record should be made of every paint job. Such a record should include the date of the previous painting, the condition of the structure at the time of painting, the condition of the surface—whether damp or dry, clean or containing old paint—and the presence of hidden defects. If of importance, the latter should be reported promptly so that they can be cared for at once to prevent the possibility that they may become extensive and require expensive repairs later.

Original painting records should be made by the paint-gang foreman, showing the date of application of each coat; the brand and manufacturer's name; whether the paint was applied to a clean or a cleaned surface, or over old paint; the condition of the old paint, the method of preparing the surface, that is, washing, scraping, brushing, burning, filling, puttying, etc. The number of men engaged on the job, their rates of pay and the number of hours at each rate should be given, and the amount of each kind of material used.

When records containing this essential information, as well as any incidental information that may be desired, have been built up for all of the structures, including both bridges and buildings, guess work will cease, for the division and supervisory officers who should have copies of the records will have reliable information in sufficient detail to enable them to know almost at a glance what their painting is costing and what results they are getting.

News of the Month



Lang Elected Head of Welding Society

P. G. Lang, Jr., engineer of bridges of the Baltimore & Ohio, with headquarters at Baltimore, Md., was elected president of the American Welding Society at the annual meeting of this organization. As chairman of its bridge committee, Mr. Lang has long been active in the affairs of this association.

Expect Increase of 6.2 Per Cent in Loadings

Based on estimates compiled by the 13 Shippers' Regional Advisory Boards, freight car loadings in the fourth quarter of 1937 are expected to be about 6.2 per cent above actual loadings in the same quarter in 1936. With these estimates as a basis, freight car loadings of the 29 principal commodities will be about 6,639,000 cars in the fourth quarter of 1937, as compared with actual loadings of 6,248,684 cars in the corresponding period of last year. Eleven of the 13 boards anticipate that loadings in their regions in the final quarter will be greater than for the corresponding period of last year. The greatest increase (27 per cent), according to the estimates, will take place in the Southwest region, while the smallest increase (2.2 per cent) is expected to take place in the Central Western region. It is anticipated that car loadings will show decreases in the Ohio Valley and Pacific Northwest regions.

Train Employees Get Wage Increase

Members of the five transportation brotherhoods will get an increase of 44 cents a day in wages, effective October 1, as the result of an agreement which was reached at Chicago on October 3 between representatives of 86 railroads and the brotherhoods. The agreement also provides for adjustments in mileage rates, daily earnings minima, monthly rates and guarantees. The monthly rates of certain dining car stewards and yardmasters will also be increased $13.20. The increase of 44 cents a day is expected to add an average of 6.6 per cent to the workers' annual earnings. The agreement will affect approximately 250,000 workers and will add approximately $35,000,000 to the railroads' annual payroll.

The agreement is the outcome of extended negotiations which grew out of the unions' demand for a 20 per cent increase in wages. Negotiations over this demand between representatives of the carriers and the unions were begun at Chicago on August 11, but terminated on August 25 without an agreement having been reached. At the request of both sides, the National Mediation Board then instituted proceedings which resulted in the agreement described above.

Grade Crossing Accidents Increase

A total of 858 persons lost their lives in the first six months of 1937, as a result of accidents at highway-railroad grade crossings, according to the Safety Section, Association of American Railroads. This was an increase of 100 compared with the number of fatalities in the same period last year and an increase of 128 compared with the corresponding period in 1935. Persons injured totaled 2,496 for the first half of 1937, an increase of 226 compared with the corresponding period in 1936 and an increase of 331 compared with the same period in 1935. Accidents at grade crossings in the six months' period this year numbered 2,168, an increase of 239 compared with the six months' period last year and an increase of 339 over 1935.

Railroads to Exhibit at Golden Gate Exposition

Eight railroads and the Railway Express Agency have already contracted or negotiated for exhibition space at the Golden Gate International Exposition, which is to be held on Treasure Island (artificially built) in San Francisco Bay during 1939. Many of the exhibits will be presented in a large building, to be known as Vacationland, in which will be shown the exhibits of the Union Pacific, the Chicago & North Western, the Railway Express Agency, the Chicago, Milwaukee, St. Paul & Pacific, the Chicago, Burlington & Quincy, the Western Pacific and the Pennsylvania. The Southern Pacific and the Atchison, Topeka & Santa Fe are contemplating the presentation of exhibits in separate structures adjoining the main transportation building.

Railroads Not Liable in Side-of-Train Collisions

When an automobile collides with a train that has stopped temporarily on a grade crossing at night in connection with switching operations, the driver cannot recover damages from the carrier, according to a recent decision of the Ninth Circuit Court of Appeals. According to the testimony offered in the case, a seven-car "dead-head" passenger train of the Northern Pacific, operating near Butte, Mont., was stopped on a highway crossing at about 10 p.m. to allow a member of the crew to get off for the purpose of throwing a switch. During the brief halt, a motorist drove his car against the side of the train, sustaining injuries to himself and the car, for which he sued the railroad. The court concluded that the evidence presented did not establish negligence of the railroad, but actually that the plaintiff's own negligence caused the collision, the testimony showing that, despite the darkness of the night, and the blackness of the car and the highway, the coach could have been seen by the plaintiff.

Judge Fletcher Hits Regulation

The railroads would be in a much more favorable position than they are today if governmental regulation of them was no more stringent than that imposed in 1906, according to Judge R. V. Fletcher, vice-president and general counsel of the Association of American Railroads, in an address before the Illinois Chamber of Commerce. Judge Fletcher asserted that "with the possible exception of security regulation we have not wisely served the public interest by the adoption of all the regulating and restricting measures that have come into the law since the adoption of the 1906 amendments to the Interstate Commerce Act" and expressed the belief that "we would help the situation immensely if we would go back to the comparatively simple system of regulation" which the amendments that were passed in 1906 rounded out.

As harmful pieces of legislation that have come into existence since that year he listed the power of the Interstate Commerce Commission to suspend proposed rates, the "innovation which gives perpetual life to a commission order," the Valuation act, the "elaborate plan for the consolidation of railroads," and the Emergency Transportation Act of 1933.

Acetylene Association To Meet at Birmingham

The thirty-eighth annual convention of the International Acetylene Association will convene at the Tutwiler hotel, Birmingham, Ala., on November 10-12. As in past years, the program will consist of the presentation of committee reports and addresses on subjects of interest to those who are concerned with the use of acetylene in welding and cutting operations. Two "round table" discussions are to be held, one on Wednesday evening and the other on Thursday evening. At these sessions various subjects of pertinent interest will be discussed by prominent persons in the industry. Of particular interest to railroad men will be a paper entitled "Butt-Welding of Railroad Rails," by R. R. Cummins, assistant general manager, Central of Georgia, Savannah, Ga., which will be read Wednesday afternoon. Two papers dealing with different aspects of the hardening of metal by the oxy-acetylene process will be presented at the afternoon session on Friday.

Personal Mention

General

O. K. Lawson, assistant cost engineer on the Chesapeake & Ohio, with headquarters at Hinton, W. Va., has been promoted to yardmaster, with headquarters at Handley, W. Va.

J. G. Woodall, assistant roadmaster on the St. Louis-Louisville division of the Southern, with headquarters at Louisville, Ky., has been appointed trainmaster of terminals of the Cincinnati, New Orleans & Texas Pacific (part of the Southern System), at Cincinnati, Ohio.

George C. Wendling, division engineer on the Louisville & Nashville, with headquarters at Birmingham, Ala., has been promoted to superintendent of the Birmingham division with the same headquarters.

Mr. Wendling has been in the service of the L. & N. continuously for 23 years. He was born on October 1, 1888, at Walton, Ind., and received his technical education at Purdue University, graduating with a degree in civil engineering in 1914. He entered railway service with the L. & N. on May 27, 1914, as a draftsman in the chief engineer's office. Two years later he was sent to the Louisville division as an instrumentman, and after about six months in that capacity he returned to the chief engineer's office as a draftsman. On June 18, 1917, Mr. Wendling was promoted to assistant engineer on the Nashville division and on October 1 of the following year he returned to the chief engineer's office in the same capacity. On July 1, 1921, he was appointed roadmaster of the Nashville division, which position he held until August 1, 1931, when he was further advanced to division engineer of the Memphis division. From January 16, 1934, to October 8 of the same year he was assigned to the position of assistant division engineer on the Louisville division, then being reappointed division engineer, this time of the Birmingham division. He was holding the latter position at the time of his recent appointment as superintendent of the Birmingham division, which was effective on October 16.

George C. Wendling

Engineering

C. M. Burpee has resigned as vice-president of the Chipman Chemical Company, with headquarters at Chicago, to return to his former position as research engineer of the Delaware & Hudson at Albany, N. Y., effective October 1.

R. M. Leeds, assistant division engineer on the Louisville & Nashville, with headquarters at Louisville, Ky., has been promoted to division engineer at Birmingham, Ala., to succeed **G. C. Wendling,** whose promotion to superintendent is noted elsewhere in these columns. **J. B. Cochran,** track supervisor at Springfield, Tenn., has been promoted to assistant division enginer at Louisville, to succeed Mr. Leeds.

Gordon H. Beasley, assistant engineer on the Eastern Kentucky division of the Louisville & Nashville, who has been promoted to division engineer of the same division, with headquarters at Ravenna, Ky., as reported in the October issue of *Railway Engineering and Maintenance,* has been in the service of this company for nearly 19 years. He was born on September 29, 1894, at Williamstown, Ky., and received his higher education at the University of Kentucky. He entered railway service with the L. & N. on January 1, 1919, as an instrumentman at Ravenna. In May, 1923, he was assigned to the chief engineer's office at Louisville, Ky., as a draftsman, holding this position until July, 1924, when he returned to Ravenna as senior instrumentman. On July 1, 1925, Mr. Beasley was appointed assistant engineer at Ravenna, which position he was holding at the time of his recent appointment as division engineer, which was effective on September 4.

Howard C. Forman, whose appointment as assistant division engineer of the Cumberland Valley division of the Louisville & Nashville, with headquarters at Middlesborough, Ky., was reported in the October issue, has been identified with the L. & N. for seventeen years. He was born on August 11, 1895, in Owen County, Ky., and after obtaining his high school education at Williamstown, Ky., he entered the University of Kentucky, graduating in 1920. In August, 1917, following the completion of his junior year in college, Mr. Forman entered the second officers training camp at Ft. Benjamin Harrison and was commissioned a second lieutenant. During the war he served overseas in both France and Germany in the army of occupation, re-entering college in September, 1919. Immediately after his graduation Mr. Forman obtained a position with the Department of Highways of the State of Kentucky. In October, 1920, he resigned to enter the service of the L. & N., as an instrumentman on the Eastern Kentucky division. In November, 1927, he was sent to the chief engineer's office at Louisville as a draftsman, being advanced to assistant engineer in January, 1929. Two years later he was transferred to the Cumberland Valley division, where he was located at the time of his recent promotion to assistant division engineer of the same division with headquarters at Middlesborough, Ky.

Track

R. L. Ruckel, maintenance inspector on the Baltimore & Ohio Chicago Terminal, has been promoted to supervisor, effective October 1, to succeed **William Hogan,** who has retired.

C. B. Shepard, roadmaster on the Chicago, Rock Island & Pacific at Little Rock, Ark., has been transferred to El Reno, Okla., to succeed **W. A. Gunderson,** who, in turn, has been transferred to Little Rock.

Charles W. McFarland, foreman carpenter on the Reading division of the Reading, with headquarters at Reading, Pa., has been promoted to the newly created position of master carpenter on the Reading division, with headquarters, as before, at Reading.

J. C. Skinner, assistant supervisor on the Philadelphia Terminal division of the Pennsylvania, at Philadelphia, Pa., has been transferred to the Philadelphia division, with headquarters at Downington, Pa. **W. F. Neale, Jr.,** acting assistant supervisor, has been appointed to the same position on the Philadelphia Terminal division, with headquarters at Philadelphia.

W. H. Johnson, a section foreman on the Canadian National, with headquarters at Capreol, Ont., has been appointed acting roadmaster, with the same headquarters, to succeed **E. Haystead,** who has been granted a leave of absence because of ill health. **J. P. Owen,** section foreman at Bangor, Sask., has been promoted to roadmaster, with headquarters at Kindersley, Sask., to succeed **T. J. Patton,** who has retired.

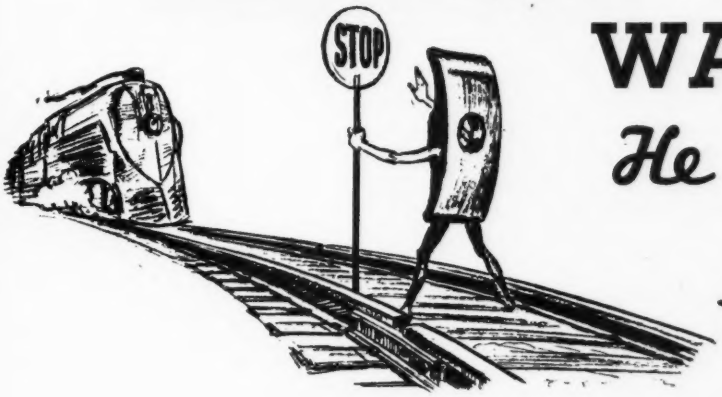
E. J. Huelsman, extra gang foreman on the Cleveland, Cincinnati, Chicago & St. Louis, has been promoted to track supervisor, with headquarters at Bellefontaine, Ohio, to succeed **Fred Hiatt,** who has been transferred to Middletown, Ohio, where he succeeds **J. T. Martin,** who has retired. **M. W. Kniery,** track supervisor at Litchfield, Ill., has retired and his territory has been placed under the supervision of **A. Haxton,** track supervisor, with headquarters at Hillsboro, Ill.

William Ryan, whose retirement as supervisor of track on the Staten Island Lines of the Baltimore & Ohio was noted in the October issue, was 66 years old at the time of his retirement, and had been in railroad service for 49 years. Starting railroad work as a laborer on the Housatonic Railroad (now the Berkshire division of the New York, New Haven & Hartford) in March, 1888, Mr. Ryan was soon promoted to track foreman, and, from 1905 to 1914 was an extra gang foreman on a number of large construction projects on the New Haven. In the latter year, he left that road to become a track supervisor for the Public Service Commission of the State of New York, engaged in subway construction in New York City, and in September, 1918, he

VERONA

Fixed Tension TRIFLEX WATCHMAN

He will prevent



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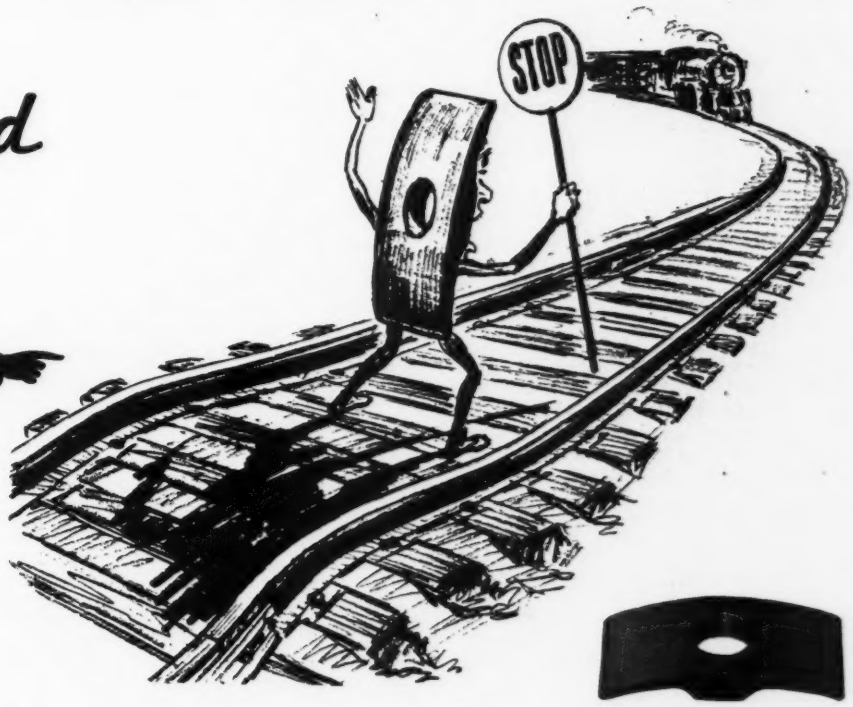


. . . by providing equal bolt tension, in addition to which he provides a reaction more than two and one-half times the A. R. E. A. specifications

TRADE MARK

Since 1873

WOODINGS-VERONA TOOL WORKS

VERONA, PA.

went with the Staten Island Rapid Transit Railway in the same capacity, where he continued until his retirement.

J. W. Thompson, general foreman in the track department of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to roadmaster, with headquarters at Beloit, Wis., to succeed **W. Zimmerman,** who has retired. **M. E. Noel,** also a general foreman, has been promoted to roadmaster at Beloit, to succeed **A. J. Barbee,** who has also retired. **C. O. Henry,** general foreman, has been promoted to roadmaster with headquarters at Red Wing, Minn., to succeed **L. Wohlert,** who has been transferred to Terre Haute, Ind., to succeed **W. T. McNamara,** who has been granted a leave of absence.

W. F. Scott has been appointed assistant supervisor of track on the Reading, at West Trenton, N.J., to take the place of **Harry L. Locke,** who has been transferred to the office of the general manager, at Reading, Pa. Mr. Locke succeeds **Harry F. Bressler** who has been promoted to supervisor of track, with headquarters at Gordon, Pa., to take the place of **Harry F. Smith,** who has been transferred to West Milton, Pa., to fill the vacancy created by the death of **Charles L. Wieand,** as announced in the October issue.

Mr. Bressler was born on November 18, 1906, at Lock Haven, Pa., and received his higher education at Pennsylvania State College, from which he was graduated in 1928. Immediately following graduation, he entered the employ of the Reading in the construction department, with headquarters at Williamsport, Pa., but on August 16, 1929, he was transferred to the maintenance of way department, as an assistant track supervisor, with headquarters at Reading. On June 22, 1932, he was furloughed, but on April 1, 1934, he was returned to active service as an assistant supervisor in the division office at Tamaqua, Pa. On September 8, 1936, he was transferred to Pottstown, Pa., and on March 1, 1937, he became an assistant supervisor in the office of the general manager, at Reading, where he was located at the time of his recent promotion to supervisor, at Gordon.

Christian S. Collier, who has been promoted to supervisor on the Illinois Central, with headquarters at Clinton, Ill., as announced in the October issue, was born on December 2, 1892, at Peoria, Ill. Mr. Collier was educated at Bradley College, Peoria, and entered railway service on August 1, 1917, as a chainman on the Illinois Central at Chicago. In the following year he was promoted to rodman, and in 1920, he was made an instrumentman in the maintenance department on the Illinois division, with headquarters at Champaign, Ill. In 1923, he was transferred to the construction department as an instrumentman on track elevation work at Champaign, being promoted to assistant engineer in the construction department, with headquarters at Chicago, in 1924. Five years later Mr. Collier returned to the maintenance of way department, serving as an instrumentman and rodman on the Springfield division until his recent promotion to supervisor.

Walter C. Peters, who has been appointed roadmaster on the Atchison, Topeka & Santa Fe, with headquarters at Newton, Kan., as reported in the October issue, has been connected with this company for 23 years. He was born on February 5, 1895, at Peoria, Ill., and after a common school education he entered the service of the Sante Fe on March 4, 1914, as a laborer. On April 1, 1915, Mr. Peters was made an extra-gang timekeeper, and from December 1 of the same year to May 3, 1916, he again served as a laborer. At the end of this period Mr. Peters was promoted to track foreman, with headquarters at Sedgwick, Kan., serving alternately in this capacity and as extra-gang foreman until December 1, 1926. On that date he was made yard foreman at Wichita, Kan., where he remained until March 1, 1929, when he was promoted to roadmaster of the Strong City, Salina and Minneapolis districts, with headquarters at Abilene, Kan. On September 1, 1931, Mr. Peters returned to Wichita as yard foreman, where he remained until his recent reappointment as roadmaster, which was effective on October 1.

George J. Goolic, general track foreman on the Staten Island Rapid Transit Lines of the Baltimore & Ohio, who has been appointed supervisor of track, with headquarters at St. George, Staten Island, N.Y., as reported in the October issue, has served this company continuously for more than 21 years. He was born on November 1, 1897, at Staten Island, and, after a public school education, he entered railway service with the Staten Island Rapid Transit Lines on March 29, 1915, as a supervisor's clerk. On March 1, 1917, he was appointed a material clerk and on June 20 of the same year he became an inspector. Later in that year Mr. Goolic was promoted to chief clerk to division engineer and on January 1, 1919, he became assistant chief clerk to division engineer. On May 1, 1931, Mr. Goolic was made a transitman and after three years in this capacity he was further promoted to general foreman, the position he was holding at the time of his recent promotion to track supervisor.

V. R. Lukoskie, who has been appointed supervisor of track on the Alton, with headquarters at Bloomington, Ill., as announced in the October issue, has been connected with this company continuously for 21 years. He was born at Braidwood, Ill., on December 11, 1902, and after a grade-school education he went through high school by taking an evening course, and also studied the roadmaster's course offered by the International Correspondence Schools. He entered railway service with the Chicago & Alton (now the Alton) on June 2, 1916, as a water boy, shortly thereafter being made a timekeeper. On September 1, 1917, he was advanced to assistant extra-gang foreman and on November 16, 1920, he was promoted to section foreman, with headquarters at Lockport, Ill. From May 11, 1922, to November 16, 1928, Mr. Lukoskie alternated between the positions of section foreman and extra-gang foreman and at the end of this period he was made yard foreman at Bloomington, Ill. On November 16, 1932, he was promoted to supervisor, with headquarters at Joliet, Ill. On February 5, 1933, when supervisors' territories were lengthened as an economy measure, Mr. Lukoskie was appointed trackmaster at Bloomington, the position he was holding at the time of his recent promotion to supervisor of track.

A. H. Exon, assistant supervisor on the St. Louis-Louisville division of the Southern, with headquarters at Princeton, Ind., has been promoted to track supervisor, with headquarters at Huntingburg, Ind., to succeed **F. A. Burroughs,** who has been transferred to the Birmingham division, with headquarters at Pell City, Ala., where he replaces **J. H. Butler,** who has been transferred to Bremen, Ala., to succeed **U. H. Lawler,** deceased. **A. C. Jones** has been appointed assistant supervisor, with headquarters at Princeton, to replace Mr. Exon.

T. W. Kinsley, assistant supervisor at Birmingham, Ala., has been promoted to track and bridge and building supervisor of the New Orleans Terminal Company (part of the Southern System) at New Orleans, La., to succeed **T. Crawford,** who has been advanced to assistant roadmaster on the St. Louis-Louisville division, with headquarters at Louisville, Ky., to replace **J. G. Woodall,** whose appointment as trainmaster is noted elsewhere in these columns. **John P. Mumford** has been appointed assistant supervisor at Birmingham, to replace Mr. Kinsley.

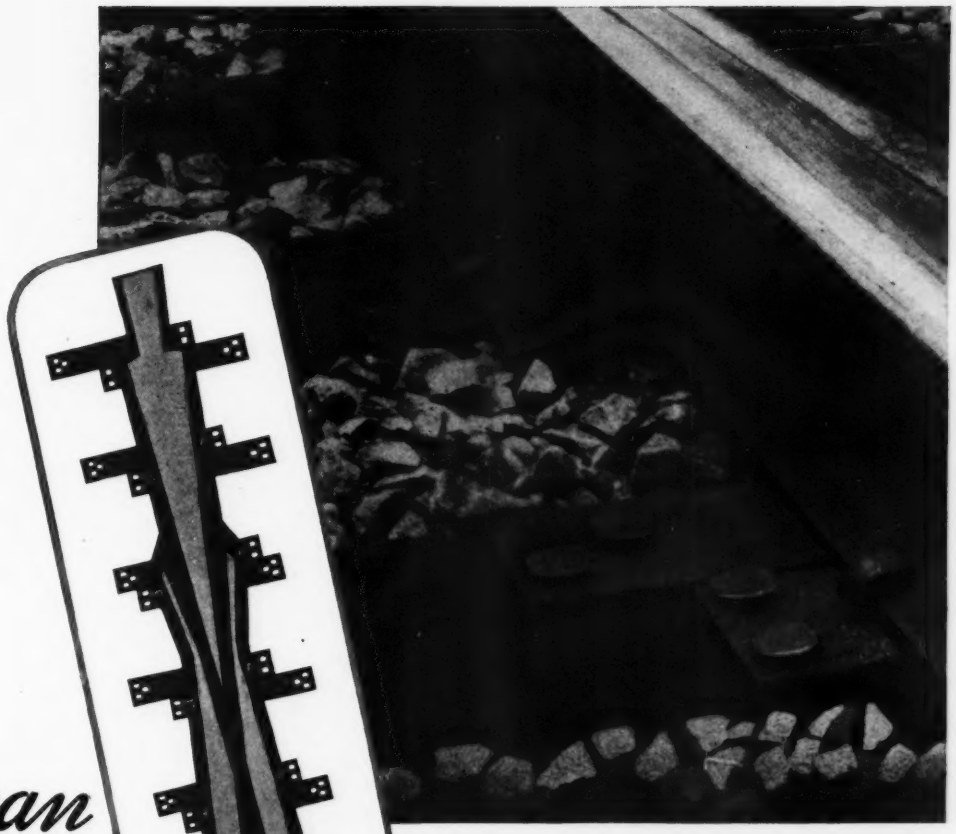
J. R. Brosnan, assistant to roadmaster on the Cincinnati, New Orleans & Texas Pacific (also part of the Southern System), south end, with headquarters at Somerset, Ky., has been promoted to track supervisor on the Mobile division, with headquarters at Selma, Ala., to replace **A. W. Stone,** who has been transferred to the St. Louis-Louisville division, with headquarters at Princeton. Mr. Stone succeeds **F. S. Cooper,** who has been transferred to the C.N.O. & T.P., with headquarters at Lexington, Ky., to replace **W. L. Bell,** who has been transferred to Williamstown, Ky., to succeed **N. Strunk,** resigned. **Leslie Woodall, Jr.,** has been appointed assistant to roadmaster on the C.N.O. & T.P., with headquarters at Somerset to replace Mr. Brosnan.

Bridge and Building

C. C. Mullen has been appointed assistant bridge and building supervisor on the New Orleans & North Eastern (part of the Southern System), with headquarters at Hattiesburg, Miss., to succeed **J. J. Steadham,** who has retired after 53 years of service with the N.O. & N.E.

W. A. Sweet has been appointed general foreman of bridges and buildings and water service of the Middle division of the Atchison, Topeka & Santa Fe, with headquarters at Newton, Kan., to succeed **Edward Drury,** who has retired after 42 years of service with this company.

Mr. Sweet was born at Sioux City, Iowa, on November 3, 1899, and after a grade school education he continued his studies through the International Correspondence Schools. He entered railway service on June 14, 1920, with the Santa Fe as a



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EVERY rigid frog on your road—whether solid, railbound or bolted; regardless of weight of rail or angle of frog—can be fitted up with a combination of three or four sizes of Bethlehem Twin Frog Plates.

These tie plates are used in pairs, two to a tie. Each is anchored with two or three spikes (provision is usually made for four). Each has a forged hook which clamps the frog flange to the plate more firmly, more securely, than the track spike which would otherwise be used.

Made in three standard lengths: 23, 27 or 31 inches. However, can be furnished in any length. Consult with one of our track specialists to determine the combination of Bethlehem Twin Frog Plates which will fit up all your frogs. Eliminate your inventory of special plates suitable only for each particular size and type of frog.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

carpenter helper and after a year in this capacity he was made a carpenter. During 1924 and 1925 he worked as a relief bridge inspector on the Middle division, being promoted to bridge foreman on April 1, 1927. He was serving in the latter capacity at the time of his recent promotion to the position of general foreman of bridges and buildings and water service.

Martin Meyer, chief clerk to the supervisor of bridges and buildings of the Chicago & Western Indiana, has been appointed supervisor of bridges and buildings, with headquarters at Chicago, succeeding **R. C. Kendall,** retired.

William Schortemeyer, bridge and building foreman on the Cleveland, Cincinnati, Chicago & St. Louis, has been promoted to supervisor of bridges and buildings, with headquarters at Indianapolis, Ind., to succeed **Court Fisher,** who has retired.

Obituary

Michael J. DeNiff, formerly supervisor of track on the Erie, and at the time of his retirement on January 1, 1937, supervisor of crossing watchmen, died at his home in Jersey City, N.J., on October 6.

J. B. Gaut, who retired on September 30 as superintendent of bridges and buildings of the Grand Trunk Western, with headquarters at Detroit, Mich., died on October 4 at Versailles, Ill. Mr. Gaut was born in 1872 and entered the service of the Grand Trunk (now a part of the Canadian National) in 1912 as a bridge inspector at Montreal, Canada. In 1914, he was appointed superintendent of bridges and buildings of the Grand Trunk Western, serving first in this capacity at Chicago and later at Detroit.

Thomas B. Turnbull, who retired on December 24, 1936, as superintendent of bridges and buildings of the Ann Arbor, with headquarters at Owosso, Mich., died at his home at Owosso on October 16 of tuberculosis. Mr. Turnbull was born on November 27, 1868, at Chicago, and first entered railway service at the age of 15 as a water boy on the Toledo & Ann Arbor (now part of the Ann Arbor). Subsequently he was advanced through various positions to that of master carpenter in 1896. Subsequently he was made superintendent of bridges and buildings for the entire railroad.

Walter Constance, supervisor of reclamation of the Chesapeake & Ohio, with headquarters at Barboursville, W. Va., who died on September 10, as reported in the October issue, was born on December 7, 1877 in Montgomery county, Mo. Mr. Constance first entered railway service in 1898 with the Atchison, Topeka & Santa Fe at Topeka, Kan. In 1901, he left this company to go with the St. Louis-San Francisco, where he served successively as a blacksmith, hammersmith and foreman in charge of reclamation. For a time beginning in 1922, Mr. Constance was employed in the Oklahoma oil fields as a tool dresser and inspector. On December 1, 1923, he entered the service of the Chesapeake & Ohio as supervisor of reclamation.

Association News

Metropolitan Track Supervisors Club

A paper on the organization of track forces by Thomas Langan, supervisor of track, Delaware, Lackawanna & Western, was presented before a meeting of the club on October 28 at the Hotel McAlpin, New York.

Roadmasters' Association

President W. O. Frame has set November 15 as the tentative date for a meeting of the executive committee, at which the organization of committees for the ensuing year will be perfected. The Hotel Stevens, Chicago, has been selected for the next annual convention, which will be held on September 20-22, 1938.

Maintenance of Way Club

The relationship between railroad employees and the managements was the subject of an address presented before a dinner meeting of the club at the Auditorium Hotel, Chicago, on October 25, by C. R. Young, manager of personnel of the Illinois Central. Eighty members and guests were in attendance.

Bridge and Building Association

On Thursday afternoon, October 21, following the adjournment of the convention, C. M. Burpee, newly elected president, called a meeting of the executive committee at which measures were initiated for the organization of the work for the ensuing year and committee chairmen tentatively selected. It was voted also to submit a questionnaire to members as heretofore, calling for volunteers for service on technical committees to prepare reports for the next convention.

American Railway Engineering Association

Supplements to the manual containing revisions and additions adopted at the convention last March were mailed to members early in October. The first bulletin to contain reports of committees for consideration at the convention next March went into the mail late in October. The secretary's office has four more reports in hand which will appear in the November bulletin.

Twelve committees held meetings, looking to the completion of their reports, in October, as follows: Yards and Terminals, at Toledo, Ohio, on October 4-5; Economics of Railway Labor, at St. Louis, Mo., and Texarkana, Texas, on October 6-7; Iron and Steel Structures, at Chicago, on October 7-8; Rules and Organization, at Chicago, on October 8; Uniform General Contract Forms, at New York, on October 11; Waterways and Harbors, at Chicago, on October 12; Waterproofing, at New York, on October 13-14; Shops and Locomotive Terminals, at Montreal, Que., on October 15; Track, at Chicago, on October 20; Economics of Railway Operation, at New York, on October 21; Ballast, at Washington, D. C., on October 22; and Ties at Washington, D. C., and Norfolk, Va., on October 26-27.

During October tests of rails welded end to end by various processes were undertaken at the University of Illinois under the direction of the Rail Committee. This committee is also supervising tests of various designs of rail joints installed with new rail in the tracks of the Santa Fe near Streator, Ill., and of the Pennsylvania near Valparaiso, Ind. The association is also participating with other organizations in the study of boiler feed waters, which investigation is being conducted at the United States Bureau of Mines, College Park, Md.

Wood-Preservers' Association

Members of the executive committee met at Chicago on October 19 to complete plans for the thirty-fourth annual meeting. In addition to formulating plans for the technical program, arrangements were made for a Users' Day session, as heretofore, on Wednesday forenoon, at which railway officers and other users of treated timber will relate their experiences. Plans were also initiated for a joint meeting with the engineering societies of Chicago on Tuesday evening of the convention week, at which a program on recent developments in wood preservation will be presented.

Owing to inability to secure adequate hotel accommodations in Chicago on the dates normally selected for the convention, the meeting has been set ahead to January 18-20, 1938, with the Congress Hotel as headquarters.

Supply Trade News

General

The Linde Air Products Company, unit of **Union Carbide and Carbon Corporation,** has moved its Boston, Mass., district office to 441 Stuart street. About November 1, the Linde office, now located at the Speedway plant, outside Indianapolis, Ind., will be transferred to a new building at 729 North Pennsylvania street, Indianapolis. The latter office will serve the territory extending from Louisville, Ky., north to South Bend, Ind., and from Columbus, Ohio, and Cincinnati westward to Illinois.

Personal

James A. Slater, vice president of the **National Malleable & Steel Castings Company,** Cleveland, Ohio, in charge of railway sales, was, on September 30, elected a director of the company, filling a vacancy on the board created by the death of **Oliver W. Loomis** on August 19. Mr. Slater was first employed by the National Malleable Castings Co., a predecessor of the present company, in 1897, and served in various capacities prior to 1913, when

Smoother going with CONCRETE-SUPPORTED TRACK is the next step in rail progress

ONLY A STIFFLY-SUPPORTED TRACK CAN REMAIN SMOOTH WHEN LOADED!

When concrete track support is used, wheel loads are spread sufficiently to maintain a practically uniform top-of-rail profile, *even under the weight of locomotive drivers.*

Streamlined, air conditioned, and operating on far faster schedules, today's new trains have boomed passenger business by capturing the imagination of the traveling public.

But meanwhile what of track? The brilliant record of American railroads in stepping up maintenance methods and reducing costs throughout the past 20 years does not alter the fact that many serious problems in roadbed design remain unsolved. Minor changes cannot solve these problems. Only one thing can—a *definitely supported* track that absorbs and spreads the load over a wider area of subgrade.

Because of this fact the spotlight is turned today on concrete-supported track. Installations of various types have served for a number of years in tunnels and terminals, and out on running track.

Will Reduce Trouble at Soft Spots

Although these installations have made good, you naturally will want to determine the merits and potentialities of supported track for yourself and in your own way. *May we make this suggestion:* Build a trial installation. Pick a troublesome section on an important line. This will give you the double opportunity of sharply reducing maintenance costs and giving the public a taste of new riding comfort.

PORTLAND CEMENT ASSOCIATION

Dept. 11-27, 33 West Grand Avenue, Chicago, Ill.

A National Organization to Improve and Extend the Uses of Concrete

he went to Chicago as manager of railway sales in that territory. He returned to Cleveland in 1921 and, continuing in sales work, was made assistant vice president in 1931, and vice president in 1934.

Craig W. Marshall has been appointed manager of railway sales of the **United States Gypsum Company,** with headquarters at the company's main office, Chicago. He will direct all sales to the railroads of United States Gypsum Company

Craig W. Marshall

products. Mr. Marshall began his railroad experience early as an apprentice machinist with the Union Stock Yards Railroad Company. He then attended the University of Valparaiso, Carnegie Institute of Technology, and Ohio Northern University, completing a course in civil and mechanical engineering. Shortly after leaving school Mr. Marshall entered the army as a lieutenant in the Engineer Corps. Following his discharge from the army he was employed by the Concrete Steel Company, Chicago, and soon became assistant western manager, continuing in that capacity until 1922, when he joined the American Arch Company, as district manager of the industrial department. In 1925 he was appointed eastern sales manager of the Sunbean Electric Manufacturing Company, and continued in that capacity for nearly eleven years.

E. H. Batchelder, Jr., sales manager of the **Insulite Company,** Minneapolis, Minn., has been elected senior vice-president. He has also been appointed assistant to the president of the **National Pole & Treating Co.** and assistant to the president of the **International Lumber Co.,** both of which, together with the Insulite Company, are subsidiaries of the **Minnesota & Ontario Paper Company, E. W. Morill,** executive assistant to Mr. Batchelder, has been advanced to general sales manager of the Insulite Company.

Edward R. Stettinius Jr., chairman of the finance committee of the **United States Steel Corporation,** has been elected chairman of the board of the corporation to succeed **Myron C. Taylor,** who will remain on the board as a director. Mr. Stettinius will assume his new duties on April 5, 1938. **E. M. Voorhees** will replace Mr. Stettinius as chairman of the finance committee. **Benjamin F. Fairless,** president of the **Carnegie-Illinois Steel Corporation** (subsidiary of U. S. Steel), has been elected president and a director of the parent company, effective January 1, to succeed **William A. Irvin,** who will become vice-chairman. **J. L. Perry,** president of the **Tennessee, Coal, Iron & Railroad Company** (also a subsidiary of U. S. Steel), will become president of Carnegie-Illinois to succeed Mr. Fairless, and will be succeeded by **Robert Gregg,** vice-president of U. S. Steel.

R. C. Flodin, who has been in charge of industrial tractor and power unit sales through branches, dealers and manufacturers of the **International Harvester Company,** Chicago, has been placed in charge of co-ordinating the work of the engineering, manufacturing and sales departments, as applied to the industrial and agricultural power lines, and has been succeeded by **Neal Higgins,** who has been engaged in the promotion of tractor and power equipment sales.

John May, general manager of sales of the **American Steel & Wire Company,** Cleveland, Ohio, has been elected vice-president in charge of sales to succeed

John May

Dennis A. Merriman, retired. Mr. May was born in Rockland, Me., and graduated from the University of Maine in 1905. From that year until 1908 he was employed in the engineering department of the New York Telephone Company and in February, 1909, entered the employ of the American Steel & Wire Company as a correspondent in the order department in the New York office. In May of the same year he was transferred to Worcester, Mass., as assistant to the educational director and in October returned to New York as correspondent in the electrical and wire rope sales division. In May, 1910, he was made a salesman in the electrical and wire rope sales division, which position he held until January, 1918, when he was promoted to assistant manager of sales. He held the latter position until 1922, when he was appointed manager of electrical and wire rope sales. In March, 1931, he was promoted to assistant general manager of sales of the company and in March, 1937, to general manager of sales, which position he has held until his recent promotion.

Mr. Merriman started his career in the steel business with the Ludlow-Saylor Wire Company, St. Louis, Mo. He resigned as secretary of that company to become manager of the Consolidated Steel & Wire Company, St. Louis. Later he resigned to become president of the Puget Sound Steel & Wire Company, Seattle, Wash., and when this company was acquired by the American Steel & Wire Company in 1902, Mr. Merriman became assistant general sales manager of the American Steel & Wire Company at Chicago. In January, 1926, he was promoted to general manager of sales and in April, 1928, to vice-president, the position he was holding at the time of his retirement.

Alexander W. Limont, Jr., has been appointed manager of the compressor division of the **Sullivan Machinery Company,** at Michigan City, Ind. Mr. Limont has recently been connected with E. I. Du Pont de Nemours & Co., Inc. Formerly he was connected with the Norwalk Iron Works, Norwalk, Conn., as chief engineer and later served with the Ingersoll-Rand Company.

Obituary

Percy C. Brooks, executive vice-president of Fairbanks, Morse & Co., Chicago, died in that city on October 15. He was born in Memphis, Tenn., on March 24, 1872, and was educated at the Georgia Military Academy and the Georgia School of Technology. He began his business career in Atlanta, Ga., in 1892 with the Atlanta Machine Works and in 1898 became associated with Fairbanks, Morse & Co. When the latter company organized a Canadian branch in 1906, Mr. Brooks became general manager and vice-president

Percy C. Brooks

of the enterprise, with headquarters in Toronto, Ont. During the World War this plant manufactured ammunition. Following the war Mr. Brooks was transferred to St. Johnsbury, Vt., in charge of subsidiary factories owned by the E. & T. Fairbanks Company, and in 1920 was transferred to the New York offices, where he became president of the E. & T. Fairbanks Company, president of the Moline Scale Company and vice-president of the Canadian Fairbanks, Morse Co., Ltd. In 1930 he was elected executive vice-president of the parent company, with headquarters at Chicago, which position he held until his death.

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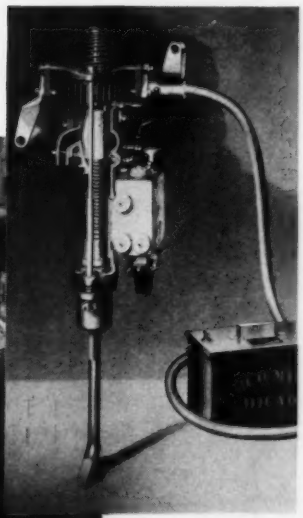
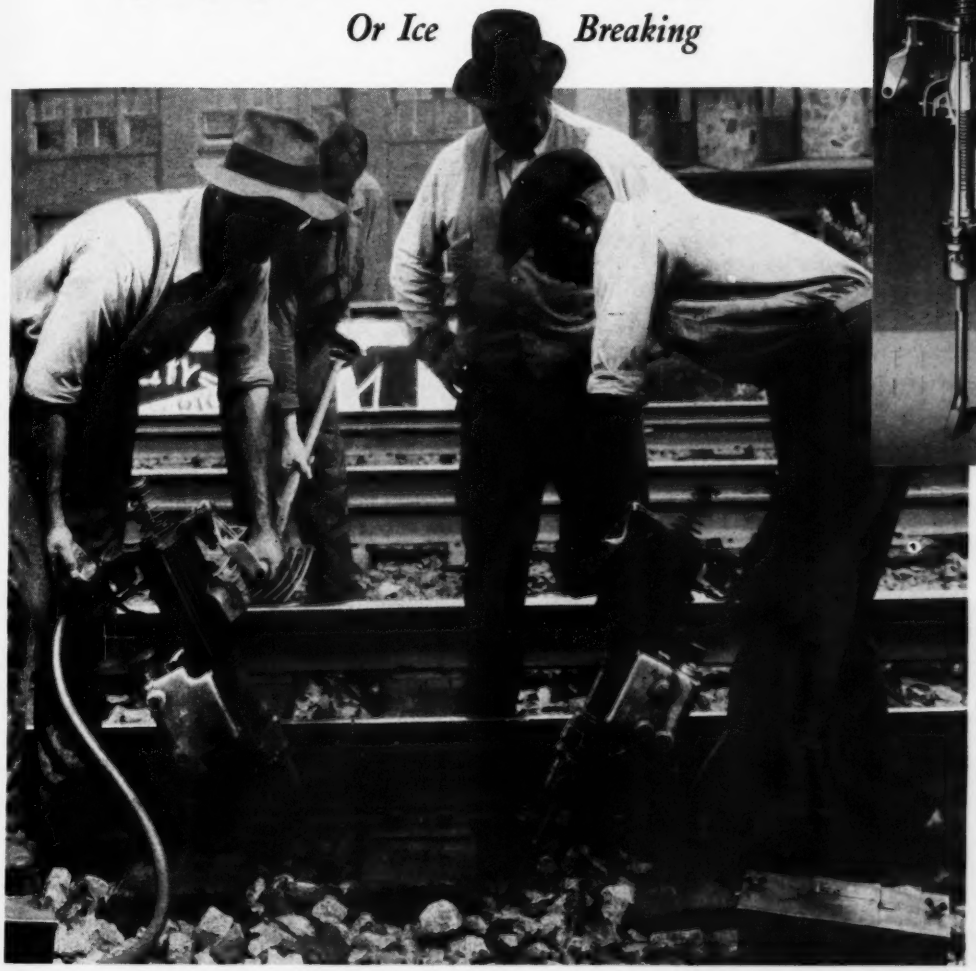
Equally Efficient For Tamping, Cribbing, Or Ice Breaking





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● One outstanding reason for the widespread purchase of Barco Unit Tytampers by so many railroads is their all year usefulness. Entirely self-contained . . . easily carried from place to place by one man . . . ready for work when they reach the job . . . these powerful, portable units save time and money on scores of summer and winter jobs, while cumbersome tie tamping equipment stands inactive.

Powered for the toughest tie tamping and crib-busting operations, Barco Unit Tytampers are equally efficient for chipping ice in terminal switches and around cross-overs . . . for breaking up frozen cinders and coal, or frozen ground. Low initial cost, and low hourly operating expense, combine with wide-range usefulness to make every Barco purchased an exceptionally profitable investment.

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Will Your Products Be in His Budget?

Maintenance officers are now turning from the current year's programs to preparations for the new year.

Tracks and structures are being examined to determine their needs.

These needs are being listed, all preliminary to a process of elimination, to bring the total outlay within the anticipated appropriation.

The problem of the maintenance officer will be one of selection.

His needs far exceed the funds that will be available to him.

He must determine which expenditures will be made—which deferred.

In reaching this decision, he will work behind closed doors.

The men who are making this decision are widely scattered, many almost inaccessible.

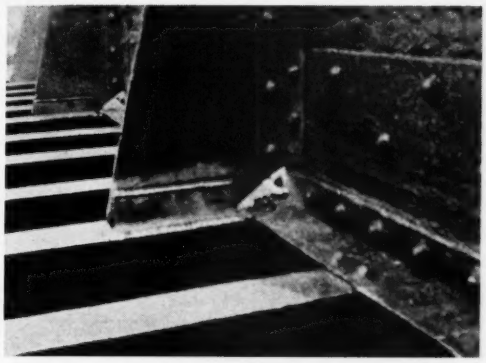
Do they know your products? Are you reaching them with your story? Are you telling it to them through the medium that reaches all of them and is welcomed by them?

The budget is the first step to sales. Once in the budget, a product is half sold. This is budget-making time.

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

MORRISON *for* ECONOMIES *in* MAINTENANCE !

For Steel Structures



Photograph showing reinforcement of girders and repairs to floor system for large western railroad.

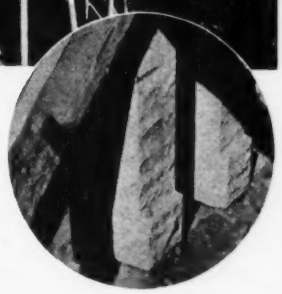
Welding The economical, practical and efficient method of repairing, strengthening or reconstructing steel bridges.

MORRISON METALWELD PROCESS INC.

For Wood Structures

The OSMOSE Process

For Wood Preservation



Photograph of fir and pine timber trestle erected in 1934 by a large eastern railroad... recently treated with OSMOSE PROCESS to check decay. Inset shows detailed method of application at ground line. Write for descriptive booklet "OSMOSE PROCESS FOR WOOD PRESERVATION."

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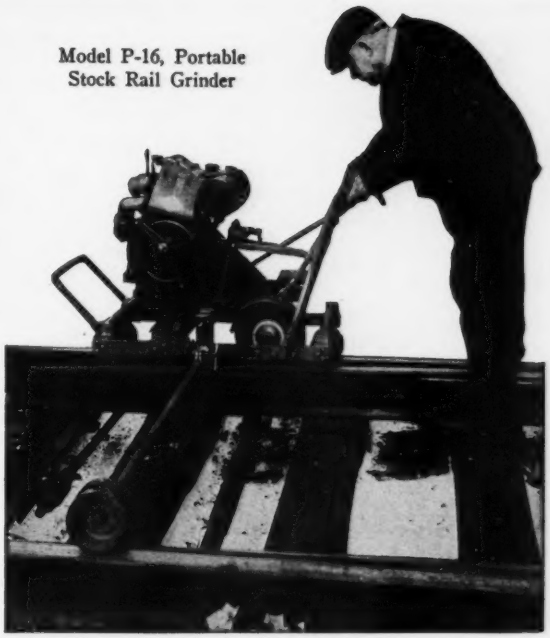

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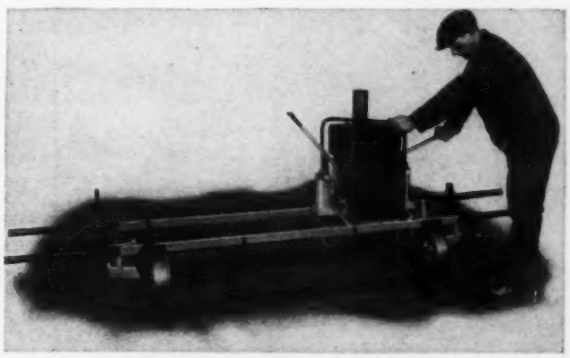

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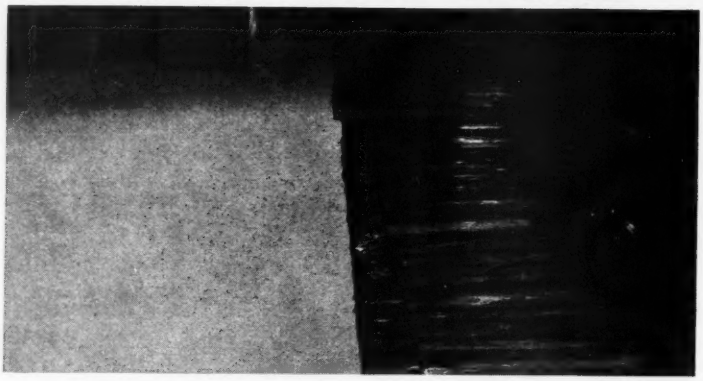

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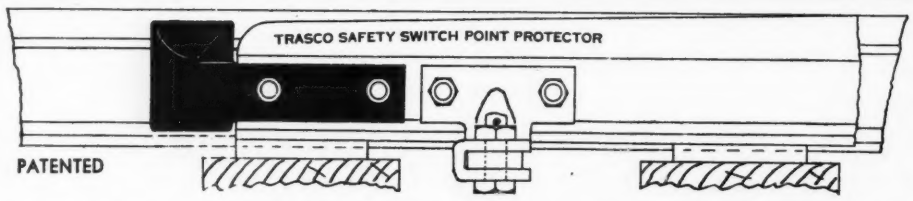

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State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the RAILWAY ENGINEERING AND MAINTENANCE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Simmons-Boardman Publishing Corp., 105 West Adams St., Chicago, Ill.
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[SEAL.] (My commission expires Dec. 10, 1939.)

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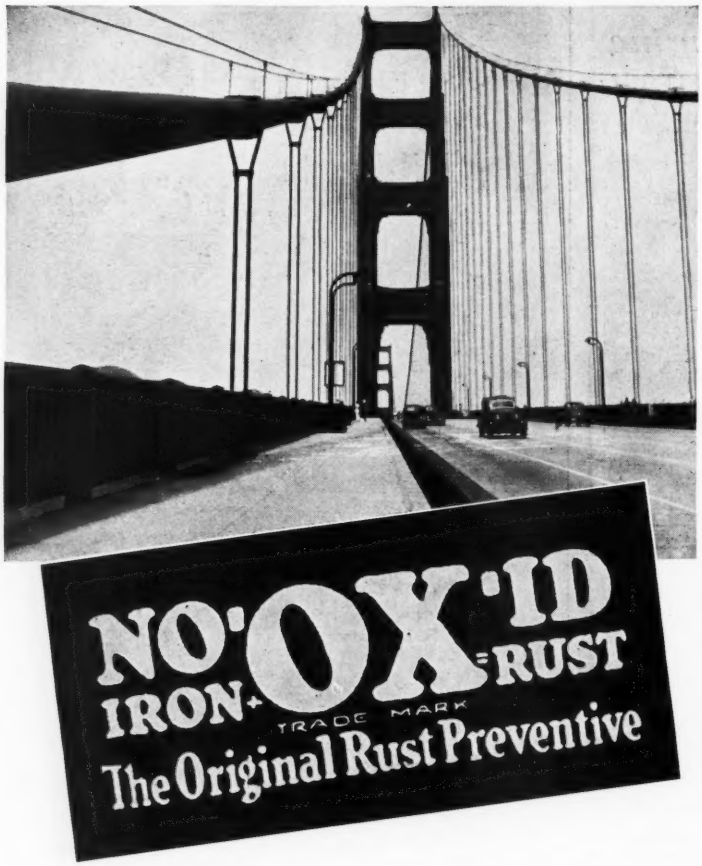

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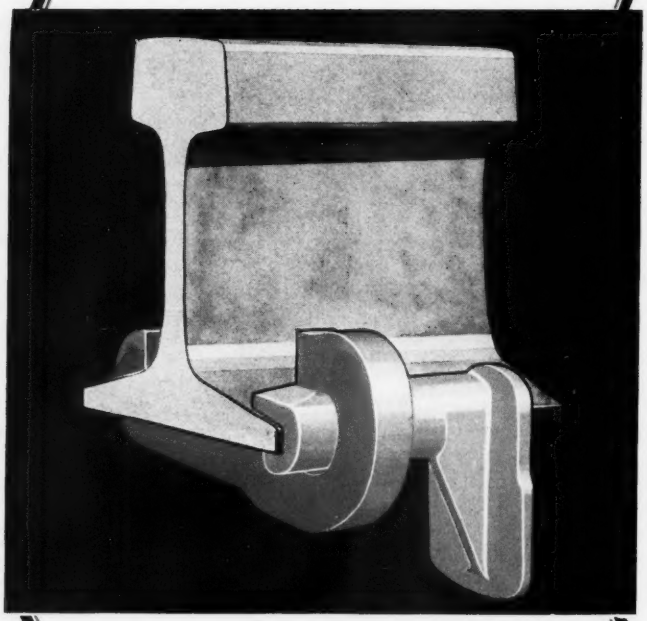

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